

Aviation Week

and Space Technology

August 14, 1961

**Unfurlable Solar
Collector Model
Is Developed**

75 Cents

A McGraw-Hill Publication

Ryan Rogallo Wing Airplane





HW14

Kaylock® 'captive washer' nut gains wide acceptance!

Since its introduction early in 1960, this new Kaylock® lightweight, all-metal self-locking nut with integral free-spinning metal washer has been specified by leading aerospace manufacturers for an increasing number of applications. Separate washers that used to drop off, roll away, and slide into hard-to-get-at places have been eliminated. The danger of short circuits, due to these forgotten washers, also has been eliminated by the new Kaylock HW14 nut-washer combination. Available in carbon steel or A286 corrosion-resistant steel.

Saves Assembly Time: Kaylock HW14's cut extra motion required to put washer on bolt. Washer can't drop off during application or removal. Cuts time lost looking for wayward washers. *Is safer, too!* Kaylock HW14 "captive washer" nuts employ the same, sure elliptical locking principle to prevent vibration hazards. The Kaylock HW14 is a development of Kaynar Mfg. Co., Inc., world's oldest and largest manufacturer of lightweight, all-metal self-locking nuts. Write today for the new Kaylock HW14 Brochure—or call your nearest Kaylock representative.



The Kaylock HW14 is available in two sizes shown above, and in other sizes to fit.

View of Kaylock HW14 3 nut washer prior to assembly.

Assembled HW143 is tight. Free spinning washer can't drop off. Only one part is loaded instead of two.

Kaylock.
Join the lightweight leaders.

KAYNAR MFG. CO., INC., KAYLOCK DIVISION
Box 2081, Terminal Annex, Los Angeles 36, Calif. Branch offices,
warehouse & representatives in Wayne, Mich., New York, N.Y.,
Atlanta, Ga., Boston, Wash., Houston, Penn., London, The Hague.



EXPANDABLE STRUCTURES: Another prime capability of Goodyear Aircraft



any other structure built. GAC designs and builds structures with wide internal and communicating systems in operating applications.

HOUSING PROJECTS 500 MILES UP!

Expandable fabric structures for space missions inherently provide the advantages of minimum structural density, maximum volume/weight ratio, unmatched packability on board—making possible full-size erection and deployment in space with minimum launch penalty.

Expandable structures are being applied to a wide range of space applications—from manned space stations and ultra-lightweight solar concentrators to in-orbit antennas where spacecraft structures are expensive, new high temperature, high-voltage fabrics. With 50 years of practical experience in developing specialized fabrics and fabric structures, Goodyear Aircraft is in a unique position to put this new technology to work at once. Whether the need is for a complete space system or major subsystems, GAC stands ready to utilize its specialized facilities—research, engineering and production. If this new approach will help your project get off the ground, write Goodyear Aircraft Corporation, Dept. 114MR, Akron 15, Ohio.

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Providing solutions for space power engineers, scientists and astronauts.

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Goodyear Aircraft Corporation, Dept. 114MR, Akron 15, Ohio.

Expandable structures, expandable structures, and other...
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The Technique is Program Evaluation The Capability is Systems Management The Company is RAYTHEON

At Raytheon, electronic analysis techniques such as U. S. Navy-developed PERT take over program verification, performance report, variance prediction. The Raytheon Program Manager, then freed from routine, can direct his efforts more profitably toward timely actions to ensure program success.

Raytheon's Surface Radar and Navigation Operations in Weymouth, Massachusetts, utilizes such advanced methods as PERT and recently installed Development Program Cost Controls to aid Program Managers in more effectively accelerating projects through the engineering phase. The Raytheon Manager also applies automated production release, product cost control, and

line-of-balance scheduling methods, in seeing the system through production — on time and within budget.

Some of these techniques are contributing to such Raytheon achievements as F28-38 and RFS-38 radar systems, and MK 74 fire control systems. All are facilitating Raytheon's development of the Modex fire control system and FAA's Bright Display radar program.

Systems management capability of this magnitude, plus highly developed technical support (documentation, product assurance, installation, training and logistics) assures Raytheon customers on-time delivery of the most complex heavy electronic systems. *Executive Office: Lexington 75, Massachusetts*

RAYTHEON COMPANY

EQUIPMENT DIVISION

RAYTHEON

packaging flexibility... **BURNDY MODULAR HYFEN** electrical connectors for single conductor, miniature and standard coax cables



ALL CONTACTS CRIMP TYPE SHAPED-LOCK

1 SELECT FRAME AND ADD INSERTS

Choice of 3, 5, 6, and 12 Insert High strength metal frames. Inserts are high dielectric glass-filled molded material with excellent insulation characteristics. Metal ferrules melted in permit frequent insertion and removal of contacts without loss of contact retention force. Inserts may be mounted from front or rear of mounting panel. Jack screws fasten plug to frame, providing necessary engaging force.



2 COMPLETE ASSEMBLY

Pins and sockets, interchangeable in plug and receptacle, may be inserted before or after inserts are in place. Inserts accommodate 25 single conductor contacts, 25 miniature coax contacts, or 10 standard coax contacts. All contacts are completely crimp-type ensuring high reliability of contact. Contacts are individually removable, preventing possibility of plug or individual contact and disconnection.



Plug assembly includes combination of single conductor, standard, coax and miniature coax contacts (up to 12 conductor contacts).

For complete engineering and specification details on the MODULAR HYFEN and other Burndy connectors for electronic use contact CRANTON DIVISION

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WORMLEIGH, CONNECTICUT

BURNDY-BURNDY INC.

Proctor, Kent, England

In Continental Europe: Siemens, Belgium

TORONTO, CANADA



INDUSTRIAL R.F. GENERATOR



VACUUM TUBE



MICRODOT PROBES



SCAN CONVERSION SYSTEM

ADVANCED

ELECTRONIC DEVELOPMENTS FROM G E C

ELECTRONIC TUBES ...

Videotubes with unsurpassed light sensitivity and low lag responding to all parts of the spectrum including near and far infrared.

FEATURES:

- 1 in. and larger sizes
 - Electrostatic and magnetic focus and deflection
 - Low power heaters
 - Patented internal construction allows operation in any position
- Scan Conversion Tubes provide controllable storage of input signal with simultaneous reading and writing.

GEC's Capability includes the design and development of a wide range of tubes, converters and display tubes.

SCAN CONVERSION SYSTEMS ...

Transferrable Scan Converters convert from any scanning format into another. One basic unit can plug-in functional modules to provide required conversion. Modules presently available are: TV Control, FPI Control, and Slow Scan Control.

FEATURES:

- Translocation of video information from one scanning mode to another
- Storage and interchange of video information
- Time-Coordinate Transformation providing expansion or reduction of bandwidth
- Rack-mounted requiring 30" in. of panel space
- Power consumption only 1.5 amp at 115 Vac, 60 cps
- No external power supplies are needed.

GEC Monoscope Cameras, Radar Target Simulators and other systems represented are available for operating scan conversion systems.

INDUSTRIAL R.F. GENERATORS ...

Inductive and dielectric heating R.F. Generators are available in the very highest powers. GEC's extensive ultra-frequency engineering is available to assist customers in special applications of R.F. Generators.

For additional information about your specific R & D needs, contact ...

..... advanced electronics at work



GENERAL ELECTRODYNAMICS CORPORATION

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Microdot Expands Facilities, Adds Reps

South Pasadena—Rapid growth of Microdot's Converter and Instrumentation Division has led to a major expansion at the Company's South Pasadena location. Production facilities for Microdot's most recent product additions—superconducting Halbach-type converters, VMEF and UHF telemetry instrumentation, and atomic measurement devices and systems—will be inaugurated by a new 30,000-sq. ft. building now under construction. Planned for completion in October, the new building will also include engineering and corporate executive offices.

In addition to the building program, appointment of sales sales representatives has been achieved coverage of the expanded instrumentation product line has been assigned by Microdot president Robert E. Dickmann.

The new firms are: Engineering Associates, Mt. View, N.Y.; Sales Associates-Northern, New Jersey; W. A. Brown & Associates, Indian River City, Florida; Elliot Sales Co., Woodlake, Ohio; Mitchell Spence & Co., Ft. Worth, Texas; Frank Frege Associates, Albuquerque, New Mexico; Bob S. Davis Associates, Seattle, Washington; Instruments for Measurement, Hollywood, California; and Rhodes Instrument Company, Woodhead, Rife, California.



Model 431 FPI Signal Generator, for check out of command receivers in the 140-350 mc bands is typical of new products produced by Microdot's Instrumentation Division. Unit features direct-chopper digital readout of frequency accurate to 1 Hz.

The Microdot instrumentation line includes integrating transducers and wide-band sweep generators, lock-in amplifiers, signal converters, signal generators, power amplifiers, telemetry transmitters and receivers.

MICRODOT INC.



220 Pasadena Avenue
South Pasadena, California



"WE HAVE NEVER REJECTED TERROR ON PRINCIPLE..."

The words are Lenin's.

Remember them... particularly when your contribution to defense—in the potential terror of space war—shares at your principles.

They'll help you know that what you do keeps fingers off buttons... that the real business of the defense business is survival.



BENDIX BRAKES GIVE TWA 200,000 BRAKE STOPS WITH NOT ONE FAILURE



B. S. Shepperson
Assistant Vice President
Engineering, TWA
Trans World Airlines, Inc.

TWA

TRANS WORLD AIRLINES, Inc.

WORLDWIDE INTERNATIONAL AIRWAY
AMERICAN CITIES AIRWAYS, INC.

March 31, 1961

Mr. B. W. McMillan
Director of Marketing
The Bendix Corporation
Bendix Products Division
South Bend, Indiana

Subject: Bendix Wheel and Brake Equipment

Dear Mr. McMillan:

A review of the performance of the Bendix wheel and brake equipment on TWA's fleet of Boeing 707-131 aircraft indicates why we in TWA have a high regard for the Bendix equipment.

With some three twenty-three months of service representing approximately 25,000 landings (200,000 brake stops), we have yet to experience a brake failure. Additionally, wheel service has been excellent. The TWA flight crew likewise share our confidence.

We feel one reason for the excellent record is the effective and responsive service support. In addition to full time representation here at TWA's Midcontinent District Office, first representation was provided throughout the training and indoctrination period as well as our jet engine and have been promptly available on call whenever questions or problems occurred.

Very truly yours,

Oliver Higgins

Oliver Higgins
Assistant Vice President
Engineering, Flight Test & Inspection

U.S.A. / 400000 / 40000 / 4000

Mr. Higgins' comments coincide with those of most commercial, military, and business aircraft people. Bendix brakes have wide appeal to all segments of the air transportation market. There have full confidence in the brakes' dependable performance. Maintenance men like the reduced turnaround time. Controllers

appreciate the lower cost-per-landing that results from use of the brakes.

The safety, dependability, and economy of these aircraft brakes stem from the superior design, quality materials, and specialized background of Bendix-world's most experienced brake manufacturer.

Bendix PRODUCTS DIVISION South Bend, IND.



ONLY RYAN DOPPLER NAVIGATORS ARE IN PRODUCTION FOR ALL THESE AIRCRAFT!

Ryan's Doppler Navigator Sets, powered by Ryan Electronics, are the most advanced and most versatile Doppler navigators yet devised.

Because of their small size, light weight, and high performance, Ryan sets meet the operational requirements of virtually every type of aircraft. Thousands of Ryan sets are now in use or in production for more than 25 types of military aircraft—including helicopters, drones and supersonic jets.

The U.S. Government looks to Ryan Electronics as a major source for Doppler navigators. Elsewhere in the Free World, other weapon systems developers are installing Ryan sets equipment in aircraft for service under the North Atlantic Treaty Organization. Ryan Electronics-Ryan Aerospace Company, San Diego, California.

REMARK DOPPLER NAVIGATORS NOW IN PRODUCTION:
ANAFPS-16 Helicopter Ground Policy Indicator, ANAFPS-12(P)
Doppler Navigator Set, ANAFPS-11(P) Doppler Navigator Set U.S.
Army Fixed Wing Aircraft, ANAFPS-10 Helicopter Hovering &
Ground Policy Indicator. —————

Ryan Electronics offers challenging opportunities to engineers.

RYAN
ELECTRONICS



this is a man you should know — a Delavan fuel injection specialist

COMPLETE ENGINEERING IS HIS RESPONSIBILITY

Engineering at Delavan doesn't end at the drawing board. It follows through all phases of design, production and testing to be sure the final product meets customer specifications and Delavan's performance standards. This is Mike Soth, a Project Engineer on main engine fuel nozzles, checking on the secondary finishing of a motorizing set. He is one of Delavan's 49-man engineering team who is mainly responsible for Delavan's reputation for quality and reliable performance. Tell us your requirements.

get to know Delavan fuel injection specialists



**GENERAL
ELECTRIC**
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LEADERSHIP IN MICROELECTRONICS

LEADERSHIP IN AERO/SPACE ELECTRONICS



NEW VAPOR DETECTOR

**Warns instantly
of toxic or explosive
vapor danger**

If you are concerned with missiles or missile fuel handling, consider three features of General Electric's Automatic Vapor Detector safety device.

IT IS EXTREMELY SENSITIVE. As sensitive as a mouse, an one-half part per million of a toxic or explosive vapor can be detected.

IT IS HIGHLY FLEXIBLE. Detector can be easily modified to detect any one of 12 vapors, including hydrocarbons and inorganic, and the list is growing. Many areas can be monitored simultaneously.

WARNING IS ALMOST INSTANTANEOUS. The sampling rate of G.E.'s Vapor Detector is approximately five times a second.

EQUIPMENT IS SIMPLE. Only a pump, sampling and alarm unit are required. All functions are fully automatic.

This vapor detector has already been selected by the Navy for a shipborne application, and can be tailored for any application where missiles or missile fuels are handled, stored or tested.

Here is another example of LMED leadership in aero/space electronics.

GENERAL ELECTRIC

Eight Military Electronics Department

Boston, New York

Another PROVEN PRODUCT FOR PROGRESS

FROM

CLEMCO

AERO PRODUCTS, INC.



3-POSITION FLAP ACTUATOR

This actuator operates the trailing edge flaps on the McDonnell F4H Naval Aircraft.

The double piston feature provides three positions for the flap surfaces with internal locking restricted. The flaps are highly preloaded in retracted position, and the lock mechanisms, therefore, are continuously operating under the dynamic load specified.

The lock segments actuate switches which provide a cockpit signal and system deenergization. Three different versions of this application have been successfully qualified to McDonnell detail specification and MIL-C-5503. The service experience is extensive dating back to 1953 on a F4H aircraft.

We accept bearing, precision of ground, safety lock and failure diagnosis and maintenance in design and construction of

ACTUATORS, Relay and Logic Systems and Hydraulic

POWER SYSTEMS AND AIRWAYS, VALVES, FLAP ACTUATORS, HYDRAULIC AND PNEUMATIC SYSTEMS, COMBUSTION AND

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Now, hot off the press... 270 pages of proven products for progress. Designs to meet your specific application of the products listed will be supplied immediately upon request.

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15251 South Main Street, Gardena, California

A subsidiary of KATHAWAY INSTRUMENTS, INC.

$$FR-100C = \frac{P_{max} + S_{min}}{\$}$$

New Ampex FR-100C

Lightweight, single-track recorder gives maximum performance in minimum space for your recorder dollar

Expand New Modular Solid-State Plug-In Circuits—combined with the world's most proved instrumentation tape transport have enabled Ampex engineers to design an exceptionally high performance recorder with great reliability and economy of operation. The new FR-100C offers:

Performance: Frequency response is 300 kc at 60 ips direct record—35 kc with FM record. Fourteen-inch reels provide 24 minutes record time at 60 ips (with 1-mil tape). Tape handling is fully responsive to the Ampex FR-100S.

Versatility: Take your choice of direct, FM and FDM recording, six tape speeds, 1" and 1/4" tapes, and up to 14 data channels and one auxiliary channel with or without log or clocking generator.

Economy: Because the new FR-100C features modular plug-in circuits, you can tailor your recorder to your immediate needs. You can specify only the features you need now without sacrificing future flexibility.

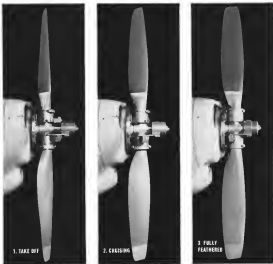
Operation: Signal inputs and outputs are available both front and back. All connections, adjustment and calibration points are easily accessible from the front. Lightweight single-track unit takes minimum floor space.

Ampex Reliability Built In. In addition to its greater versatility and economy, the four-track FR-100C is designed to the same high standards that have made Ampex recorders the standard of excellence throughout the world. For complete specifications, write...

AMPEX INSTRUMENTATION PRODUCTS COMPANY • Box 5001 • Redwood City, California • EMenue 5-7111

AMPEX

Small planes get the airline pitch



from Hartzell and Timken® steel

To help make engine and propeller start-up an "all-weather" job for the pilot, Hartzell Propeller Company designed a constant-speed propeller with full feathering and reversible pitch. Short field landings are a problem. Runways run land at a more convenient airport in many other

The resemblance is the big propeller doesn't stop there. To get the right aircraft quality steel for the propeller hubs, Hattori requests came to the Turkish Company Timken's line alloy seamless steel tubing is known for its cleanliness. And the metallurgists who make it are known for coming up with the best solution to tubing problems. Timken 4140 steel tubing of aircraft quality is cleaner. The propeller hubs can be made right at wing. And Timken steel tubing cuts repetitions because of its uniform response to heat treating. Every part is up to

THIRTY MILL STEEL AND SHAPING STEEL TURNING ARE AVAILABLE FROM STEEL SERVICE CENTERS IN 44 CITIES IN THE UNITED STATES

specification. Due to this consistent performance, Harsanyi *was* specified Thinker and/or used for their foreign.

Timken Company metallurgists have been finding solutions to tough metal problems for over thirty years. They're specialists in specifying the right mechanical tubing to keep costs and rejects down. If you have a steel problem, why not call on the Timken Company? Their experts will be glad to work with your engineers and designers. The Timken Roller Bearing Company, Steel and Tube Division, Canton, OH 44705. Circle "Timken" on Reader Service Card.

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Revised 14, 1968

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RESEARCH & MARKETING

BUSINESS			
BUSINESS MANAGER	1	5	Johnston
CORPORATION MANAGER	1	7	J. Lyons
all business managers	10	7	Conroy
MANAGERIAL MANAGER	1	1	1

Soviet Gains Blunt U. S. Bomber Potential 28
 ▶McDonnell bases his downgrading of Moscow aircraft on an assessment of Russian anti-aircraft defenses.

Polish Airline Plans Transatlantic Service 38
 ▶ LOT, state-owned airline, drafting expansion plans for 1983-85, jet equipment purchases a high priority item

Unfurlable Solar Collector Is Developed 61
 • Lightweight parabolic unit collects, concentrates enough heat for a thermoelectric or solar dynamo power system.

SPACE TECHNOLOGY

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Markus: So, the first thing I noticed when I stepped out of the car was the humidity. It was a warm blanket, almost suffocating. I'd heard the weather was bad, but this was something else. The air was thick with the scent of tropical flowers and the distant hum of traffic. I took a deep breath, trying to acclimate myself. The first building I saw was a grand, colonial-style structure with a red-tiled roof and white walls. It looked like a palace. I was in the heart of the city, and I was already feeling like an intruder.

SAFETY

Published Online: November 14, 2007

FINANCIAL	
Industry Growth Potential	5
Manager's Experience	5
Manager's Ability	5

Air Force Research Grants New Effort

Verde, E. A. 1993. *Verde, E. A.*

COVER: River Associates Co. Inc.

program financed jointly by the U.S. and the Wisconsin capability of the system. Plans is powered by a 100 hp of a four wheeled open frame body a rubber drive wing (AW June 5, p. 10).

[illegible]

65 934 copies of this issue related

A compelling challenge—is to assist the orthopedically handicapped in performing the simple and rewarding manual functions that lead to richer, more useful lives.

Working with athletic and prosthetic specialists in hospitals and medical schools, Fairchild Research and Development personnel have done considerable experimentation in this field with skin gauges, special assembled and Microlog components. Using these elements as sensing, logic, control, and feedback building blocks, it is thought that human mechanisms for commanding and verifying body motions may be closely approximated.

Problems are myriad. The challenge great. The rewards immeasurable. We believe it is a worthy goal to unlock doors in the Human Horizon. If you would like to share in a challenge such as this, and yours is a relevant background, we would like very much to hear from you.

HUMAN HORIZONS



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EDITORIAL

Vostok II's Warning

The latest Soviet feat of landing Vostok II and its occupant, Gherman Titov, into 17 orbital swings around the earth and then recovering both the capsule and its human cargo safely and precisely, according to public statement, provides a sobering yardstick by which to measure the relative progress in space technology on both sides of the Iron Curtain.

The flight of Vostok II and May Titov is a scientific achievement of the first magnitude. The Soviet scientists responsible for it deserve unqualified congratulations for proving another historic milestone in man's conquest of space. Some 7,000 of these technicians recently were awarded high Soviet decorations for their work, although communist policy still cloaks them in anonymity.

There were many legends in this country when Nikita Khrushchev also awarded himself a decoration for these space achievements, but this is hardly as unusual as some of our sophisticated would have us believe. For it was the top-level support of the Soviet Union's political leadership that in large measure gave the Russian space scientists their great opportunity to achieve these earth-shaking results, and it has been the homogeneous, close-knit approach of our own top national leaders—including many of the top scientists who recently have barked in politically appointed jobs—that labeled space technology as an effort of little importance and low national priority. This has inhibited and hamstrung our own scientific and technical talent more than anything else and is the major reason why we still run second in this field.

Conservative Drag

It is worth recalling that only last January, outgoing President Eisenhower expressed serious doubts over the value of a man-in-space program. Reflecting the ultra-conservatism that has now been belatedly cast into a home-grown American virtue, he then recommended wiping out the funds for the Apollo program until the Mercury program had been completed—whatever that might be. It also is worth recalling the scientific advice that President Kennedy first received from his top scientist, James Vannevar Bush, who led the "Full the Mercury" wing of the scientific politicians whose opposition has been related to often in the past decade both by technology and politics.

With the hindsight of this type of leadership, it is difficult to see how our abundance of technical talent and industrial resources could achieve anything better than second place in the space race. The cost of a medal to Nikita Khrushchev is a small price to pay for the support he has given his space technologists. We would be in far better shape today if the confidence of our national leadership over the past six years deserved medals of this kind. And what kind of a medal would be awarded that eminent Detroit banker, Charles E. Wilson, who as Secretary of Defense finally squashed all military attempts

to lay sound foundations for space research in the years just before Sputnik II?

Major significance of May Titov's flight lies in the field of bioastronautics, where the U. S. has yet to settle its inter-agency power fights, much less lay the foundations for a sound national program. The 25th orbital flight of Vostok II plus its paid time was a striking demonstration of the life support system the Soviets have developed and perfected to maintain operational use. According to their technical literature, this system on the Vostok capsule will support human life for a minimum of 10 days and is a representative type of system employing open-circuit.

Design Limits

A 30-day life support system would be ample for a quick round trip to the moon. In contrast, the Mercury capsule has a life support system which, including pad time, would make a 24th orbital flight a mile home, and certainly prohibits use of the capsule for any reason deeper into space. These preliminary designs for the Apollo moon vehicles are still being based on life support systems that depend on storing oxygen.

This constraint has ample precedents in properly trained medical researchers, laboratory and test facilities and experience to operate an effective bioastronautics program. But the fight for power in this area between NASA and the Air Force and the disagreement of these facilities within the military sphere have slowed progress.

It may well be that Vostok II's flight has sounded the warning that it is impossible for the U. S. lunar program smoothly established by President Kennedy to beat the Russians to a manned landing on the moon. Even if this is true, there is no reason other to abandon the Kennedy moon program or to relax our efforts across the board in space technology.

But it must be evident even to the most abstract legislator, Detroit motor magnate, or Gettysburg farmer, that the full force of the Soviet technical challenge that has been increasing in intensity since 1955 is now upon us. It must also be evident that these Soviet space, missile and astronomical achievements are neither conjuring tricks designed only to deceive the West nor are they mere bragging only by Americans supposedly interested solely in saving military budgets or oversteering the scientific pot.

It is evident that they are an integral part of the challenges to the existence of this or any other free nation. It is equally evident that our national leadership has been unable to move in facing to progress this long before a Red Air Force major celebrated the sixth 17 years and entered successfully to Russian soil.

—Robert Flota



Too big to ship, the Bendix Space Chamber is being assembled on site and is 15,000 sq. ft. building erected around it. The hard sleeve raised a right square at a top-side wall on its 3 day trip from Pennsylvania to Ann Arbor.

PROGRESS REPORT #2: BENDIX SPACE LABORATORY

On-site fabrication of a new 20' x 27' thermal vacuum chamber capable of accommodating full-sized spacecraft and capsules began at Ann Arbor on 12 July. The installation of the chamber, which will be capable of 10^{-5} mm Hg vacuum and of simulating the sun's intense radiation and the low absolute temperature of space is on schedule and will be in operation this fall. Our rapidly expanding space laboratory offers new technical challenges and career opportunities to experienced senior personnel.

Qualified applicants will receive consideration for employment without regard to race, creed, color or national origin.

BENDIX SYSTEMS DIVISION

ANN ARBOR, MICHIGAN



Washington Roundup

Space Conflict

Conflict between the military services—chiefly Air Force—and the National Aeronautics and Space Administration over respective shares in the national space program is growing in spite of all the past assurances and assurances of harmony.

USAF particularly is concerned over the military implications of space tests such as the Voth II flight (see p. 10) and over the pace of NASA's work. Most recent criticism is a NASA contract with Aerospace Corp. (see p. 20), which was viewed chiefly by NASA's technical people and space pilots.

Top Air Force officials approved the contract, in they must whenever Aerospace accepts outside work, but many working-level USAF officials consider it a sell-out and have said so.

With little notice, the Aerospace Service has completed the first U.S. reconnaissance map of the moon. It now is sketching the map and making a study of the moon's terrain. The map will form the basis of a large scale map that National Aeronautics and Space Administration hopes to complete in about 1964. The one just completed was two years in the making.

Non-Profit Contracting

Budget Bureau's comprehensive study of government contracting with non-profit organizations, which President Kennedy requested, is expected to hold off any drastic action by Congress. The report is to be completed by Dec. 1.

Congressional disapproval of contracting for technical, management and research services has grown in the past few months, particularly in the Defense Department. House appropriations committees threatened earlier this year to require that these expenditures go to the same extent that government does.

Budget Bureau's study will concentrate on whether or not people are required to oversee the non-profit group's work as would be needed to do the work itself, whether government interest should be increased or non-profit interest lowered, what criteria should be used to decide whether work should be done by government or funded out, how non-profit contractors should be selected, participation requirements are forced, especially to do a government job, what standards should be used for fair and cost allocation.

McNamara's End Run

Defense Secretary Robert McNamara has been exchanging interviews with newsmen who do not doubt the Pentagon regularly in an attempt to improve his public image. He feels that the Pentagon regularly has to deal with the public in the military services for information when they encounter reluctance to talk in the higher echelons, where political awareness is greater.

Although McNamara has been a popular witness on Capitol Hill, his past relations got off to a bad start with the famous "missile gap" background. His work seems to make him a man of the department who had to choose of military antagonism with his tactics. His countermeasures have resulted in several dozen interviews by "outsiders," and has produced favorable articles in national magazines.

Congressmen are considering holding joint sessions of the foreign relations, armed services, science energy and appropriations committees to hear the Administration's basic presentation on national security aspects of the Ford 1965 budget requests next January. This would be a big maneuver both for Congress and for McNamara in the executive branch.

Defense Secretary McNamara estimates he spent the equivalent of 36 working days going before congressional committees and 18 days preparing it in his first six months in office. Much of the time is spent serving the same things to different people.

Amiable Russians

State Department officials have been surprised by the extreme friendliness of the Russian diplomats who negotiated the New York-Moscow bilateral air transport agreement. Relations over the Berlin issue has been about the same.

Russia also talked to press its desire for traffic rights beyond New York to Hawaii and Latin America. They are expected to do this once the New York-Moscow treaty has been given a fair test. The U.S. will counter with a request for trans-Siberian rights—a route between Moscow and Tokyo.

Rep. E. F. Breaux's request for congressional action on the aircraft noise problem has the aspects of a special interest pleading. "An airplane's noise boom once deflected over California," he said. "The jet stream."

Air Force changed the title of the Strategic Air Command commander's office at Vandenberg AFB, Calif., to command, Strategic Aerospace Division, Strategic Air Command, until it discovered that this forced the acronym SADC. It quickly settled for STRATAD instead.

—Washington Staff

company United States Information Agency, called "the latest possible global system—whether it is owned and operated" by one, two, or numerous countries.

The controversy in the civilian cannot industry over the merits of a low-orbit, random orbit system versus a high-orbit, synchronous orbit system was highlighted in the Long subcommittee hearings.

AT&T favors an initial system of 25 to 40 satellites in orbit at an altitude of about 7,000 mi. This would give U.S. Europe coverage, and at times, links with other points. According to AT&T, such a system could be operational within three to four years. AT&T's main objection to the Advent concept of three satellites in synchronous orbit at a 32,000-mi altitude is that time lag and echo in voice messages make studies conversation uninteresting. AT&T wants the mechanism orbit approach developed for satellite television use in the operational system at a later date in traffic delivery.

ITT, RCA, and General Telephone & Electronics Corp.—which is still fighting vigorously but unsuccessfully for membership in the meeting on remote operations—by FCC—favor the Advent concept. This pointed out that the random orbit system would not meet the President's requirement for global coverage, while one Advent-type satellite would cover 95% of the globe and there would be complete global coverage around-the-clock.

Dr. Herbert Treiter, president of General Telephone & Electronics Laboratories, a Bell-owned subsidiary of GTE, reported that his firm has developed an orbit system that solves the echo time delay problem. The company has an Army Signal Corps unit that is manufacturing the equipment for an Advent GTE-GE-Redwood System Electronic Products is building the ground antenna system for Advent. IT&T's Hughes Aircraft and Advent-type satellite with a low-latitude orbital altitude of 10,000 mi. would provide coverage, later a three-satellite system with 1,000 channels, and still make a television channel. He estimated that the first satellites would have a lifetime of a few weeks, but anticipated that it would be possible eventually to extend this to a 20-year life span.

GTE's Treiter challenged the consistency of proponents of the random system that the system would be established earlier. Commenting that the most many random orbit system could involve 45 satellites "all of which must be manufactured, tested and launched with appropriate programs for failures," he added:

"Schedules prepared by experts in space technology indicate that the

launching time advantage for a stationary satellite system by reason of the lower number of satellites would permit a minimum of 11 more months' research and development of time, for the stationary orbit satellite, than for the random orbit satellite with the same no-service date for either system."

House Committee on Science and Astronautics was reported that although there has been "a significant lack of official comment by Soviet officials," U.S. scientists who have talked with Russian space experts state that they are fairly interested in space communications and are concentrating on the mechanism Advent-type system.

"A random orbit system could de-

veloped as before the world as a leader in space communications if Russia establishes a stationary orbit system," Treiter told the Long subcommittee. "If the U.S. went ahead with a low-orbit random orbit system it would be possible for Russia to hold back until we were deeply committed to this system and had launched perhaps 10 or 15 of the satellites and then with three satellites the Russians could establish a much worldwide system before our limited system was even in operation."

A "tracked" random system in which 10 points were given the ability to communicate directly with each other would require 400 satellites in orbit, Treiter said.

McNamara Preparing 5-Year Plan For Strategic Weapon Procurement

Washington — Defense Secretary Robert S. McNamara told the Senate Subcommittee on National Policy Matters last week that he will submit to the President "very soon" a five-year program for procurement of strategic weapons systems for control over strategic forces.

The final proposals of Air Force, Navy and Army were presented to McNamara and Defense Budget Secretary Russell G. Callahan at a 7-hr. session on Aug. 4.

Scanned, prepared proposals by Air Force and Navy were submitted to McNamara July 3. Air Force WPA reported July 21, p. 5H that these proposals included recommendations for a total 3,916 intercontinental ballistic missiles (ICBMs) for 1967, 2,490 for 1970, 1,910 for 1973, 1,410 for 1976, 1,110 for 1979, 770 for 1982, and 710 for 1985.

The program proposed by USAF was subdivided into Navy, and vice versa, and both programs were listed by Army. The final presentation by USAF and Navy included an evaluation of the proposed program of the other service, and an evaluation of both programs by the Army, McNamara said. The program was submitted by the committee and chief of staff of each service.

In making his recommendations to the President, McNamara told the subcommittee he would point out differences and note the agreement to it by individual services.

In addition to ICBMs, the five-year program for procurement of strategic weapons would include strategic bombers, tanks, amphibious vehicles and submarines and other weapons.

Subcommittee Chairman Sen. Henry Jackson (D-Wash.) also heard McNamara's report.

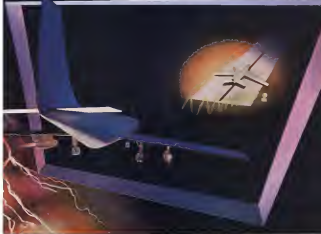
Standardization of space launch vehicles is a major goal. He said that should be one vehicle or one combination of vehicles for each payload category for use in other Defense programs.

Role and importance of the Joint Staff of the Joint Chiefs of Staff is steadily increasing during his administration, McNamara reported. The Joint Staff, being composed of experienced officers from all military services, has the potential of becoming a most valuable asset to the Department of Defense as a whole.

Recently established Defense Intelligence Agency (DIA) July 27, p. 14, will relieve "burden of effort" and a more efficient allocation of intelligence resources more effective arrangement and utilization of duplicating intelligence, facilities, organization and staff, he said.

The five-year budget is a "substantive" for a reorganization of the military establishment along functional lines and was a first step in this direction. In previous years the military establishment, W. J. McNamara, former assistant secretary of defense, recognized that defense reorganization was in itself before the new budget pattern involving central and decentralized functions, central and decentralized functions, joint purpose forces, multi-mission forces etc. McNamara said the budget structure will have "no influence whatever on the organization structure" that is, no effect on procurement according to its organization, it will leave decisions to a reorganization and "in a new relationship, a substitute for it."

Establishment of new Defense agencies on a basis of studies and reports prepared by under secretaries committees. McNamara noted that an average of less than five cents on the dollar is now being allocated on surplus sales.



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Unlike other automatic landing systems, the Bell ALS is ground-based so a pilot and observer maintain every approach and landing. It can operate either fully automatically or under pilot control. Military versions of the ALS have been ordered by the Air Force, The Navy has selected a for installation aboard the nuclear-powered aircraft carrier USS Enterprise as well as for its other large carriers.

The Bell ALS is but one among many contributions which Bell Aerospace Systems Company is making to both scientific progress and defensive strength of the free world. We strive qualified engineers and scientists to engage about sharing our the Bell and our research efforts.



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NORTH HOLLYWOOD, CALIFORNIA

THE BENDIX CORPORATION

Further 990 Write-offs Foreseen

Drug problems largely involving the engine nozzle throat severer are now playing to be an obstacle to the Convair 990 turboprop-powered transport meeting its maximum speed guarantee and will cause further write-offs as big as the \$215,000,000 for the last of 1961.

A program is under way to reduce the loss due to the nozzle area, which is lost by General Electric to a Convair design. The problem was not detected until a fully automated engine began automatic flight tests a few weeks ago.

Modifications to the outward nozzle throat because of a hot oxidation problem (AW May 12, p. 39), which Speed broke at the first test, will not be needed in the drug problem. Some study is being given to the effect of the addition of leading edge high lift devices, but no conclusion have yet been reached.

As a result of the \$114.5 million change which amounted to \$57,510,000 after taxes, General Dynamics Corp. reported a 132,420,000 dollar for the period. Last year the company reported \$12,091,111 in profit for the first half on sales of \$979 million. Sales for the 1961 first half totaled \$1,614,673.

General Dynamics director established an executive committee of five last meeting headed by Henry Crown, chairman of the corporation's Mineral Service Division. The committee will concentrate on problems of the jet transport.

Three Firms Added To Apollo Bid Request

Washington—National Aeronautics and Space Administration has added Aerojet-General Corp., Ball Corp. of America and Space Technology Laboratories to the list of companies invited to bid on Apollo and has selected Martin Marietta Institute of Technology in Huntsville, Alabama, to develop the prototype guidance and navigation system for the manned space vehicle.

NASA will hold a second bid conference at Space Task Group headquarters, Langley Field, Va., Aug. 19-21 to acquaint the three new firms with the Apollo program and the requirements who submitted unsolicited requests to bid, with Apollo's background and progress. At the same time, NASA will present to the new bidders and the 12 currently invited to bid (AW Aug. 7, p. 29) more details on the recently issued specifications for the crew and propulsion modules.

Under an estimated \$4-million contract, MIT—which has been working on a design study for the past seven months—will design and build the first several guidance and navigation systems, plus ground support and checkout equipment. Quantity production will be contracted to industry later.

With a laboratory module for controlled earth-orbit missions and an additional propulsion module for manned lunar landing missions—both of which would be mounted below the combined navigation module—the Apollo spacecraft will apparently include NASA's own design data (AW June 5, p. 28-27 and July 31, p. 29). The three-man crew will function entirely within the mission-control compartment and will routinely operate all equipment aboard the other modules, including a service module for the maintenance of the terminal propulsion unit and some power system.

Liquid hydrogen/liquid oxygen engines are specified for the main propulsion module, but the type of terminal engines are to be suggested by the bidder. NASA also has specified wing engines, burning kerosene fuels, for guidance correction.

All propulsion systems are to be controlled by the crew within the mission-control module.

Other NASA specifications include:

- Launch vehicle reliability of 0.95.
- Descent rate of 10 ft./sec. on altitude of 5,000 ft. down, apparently to be achieved by conventional parachute.
- Life expectancy for the three-man crew for a post-landing period of 72 hr. either on land or in water.

The Apollo control center will be located at the launch site and will use both the Mercury tracking network and whatever other equipment is available at the time of launch—now tentatively scheduled for January, 1967.

News Digest

Italy is claiming a world's absolute record of 9,978 ft. for aircraft with a gross weight less than 6,615 lb. The mark is claimed for an Aeromarine Manta M8 125 jet trainer powered by a Bristol-Siddeley ASV 11 turbojet developing 2,450 lb thrust. Pilot was Carlo Caracciolo who made the flight Aug. 4. Present official record is held by Russian Yak-52 trainer powered by a 1,704-lb-thrust engine, flown to 46,863 ft. last Feb. 22 by Valeriy Moshalov.

Edw. Johnson, board chairman of Tecon Instruments, Inc., and a principal shareholder of Bussell Instruments

Aerosol, has been named to the board of the current Johnson as a participant in the purchase by first jet Tecon Instruments, members of Son. (W) Louis A. Bussell's consulting interest in the strike (AW May 29, p. 14). Milton McGee, Kansas City, Mo., has resigned from Bussell's board.

S-3 composite particle satellite (AW Apr. 17, p. 14) is scheduled to be launched this week by the National Aeronautics and Space Administration aboard a three-stage Titan Delta launch vehicle. Orbit will be highly eccentric with a perigee of about 170 mi. and an apogee of about 50,000 mi.

Martin-Marietta Corp. has been chosen as the prime of the company which would result from the proposed merger of the Martin Co. and Aerojet-Martin Co. Stockholders of both firms will vote on the proposal Oct. 9. George M. Reuter, Martin chairman, would be president and chief executive officer, and Gustav M. Hansen, Aerojet-Martin chairman, would be chairman of Martin-Marietta.

Thomas F. Dixon, former vice president for research and engineering at Rockwell's Division of North American Aviation, Inc., will replace USAF Maj. Gen. Don R. Osterman, director of the Office of Launch Vehicle Programs at the National Aeronautics and Space Administration in Sept. 15. Gen. Osterman will become the vice commander of Air Force Ballistic System Division in Sept. 1.

House rules committee last week decided to let the House Commerce committee to conduct a study on reducing aircraft noise, while the Federal Aviation Agency and National Aeronautics and Space Administration announced their fourth had signed a \$106,000 noise study contract with Bell, Boeing and Newman.

First Six Four-Engine Dynatronics/Aeromarine T series engine, designed for six operations, approximately 5,000 hp down the Atlantic Missile Range on Aug. 5. Atlas, which will carry a full load of RF-1 fuel at all times and will be launched with liquid oxygen just prior to launch, is fired with gas valves on the fuel tanks and lifting out that begin any inquiries settling to the tank bottom during storage.

Discoverer XXVIII, launched Aug. 3 from Vandenberg AFB, Calif., is presently held to adverse polar orbit because of an adaptive malfunction in the attitude reference. Despite announced modifications to the Thor booster system and the Agena II control system.



LOT POLISH AIRLINES 84-passenger B-66 transport aircraft at the Warsaw-Okęcie airport. The two operators from the Soviet bloc firms, mostly on the Warsaw-Moscow route, B-16 aircraft will be extended to Paris, Rome and London this year.

Polish Airline Plans Transatlantic Service

LOT, state-owned airline, drafting expansion plans for 1963-65; jet equipment purchases a priority item.

By Fitch Wallard

Warsaw—LOT, state-owned Polish Airlines, is drafting plans to become a transatlantic carrier in the 1963-65 period and is shopping for jet equipment to fit its needs in both eastern and western markets.

But Western prospect at the moment appears to be Great Britain, where schedules may receive a Polish order for four advanced design jet transports. Details probably will be included in the first draft of a special trade agreement now being negotiated between Britain and Poland.

Western airport requirements, according to a company official in a radiofax message, at transport carrying about 60 passengers. Originally, the Polish carrier like East German Lufthansa hoped to introduce its first jet service with Soviet production models Type 112 transporters built by Yuzhnyi Mashinostroyeniye in Dnepropetrovsk along with all other East German aviation projects, production of the 152 was stopped in the country's economic stagnation and reconstruction this year (AW May 27 p. 28), and LOT is now looking elsewhere for a suitable medium-range jet transport. At present, because of political and financial reasons, Russia's new Tu-124 medium range transport is leading through a number of effects conditions for the transport order.

The Polish airline also needs a suitable replacement for its older Il-14s and La-2s and will soon evaluate on its domestic routes the new Polish 38 passenger MD-12 piston-engine, four-engine transport developed and built by the

Institute Lotniczy (Aeronautical) in Ostrova. First prototype of the MD-12 flew in 1958, but the second aircraft is being modified presently to reduce the high cabin noise level, improve cabin conditions and a change in the location of the engine exhaust ports will be introduced in the next version.

Prototype of the aircraft consists of four 38-hp, six-cylinder Polish-built Silesia engines. Maximum lift-off weight is approximately 16,000 lb, cruise altitude 6,500 ft and maximum ceiling 13,120 ft. According to LOT engineers, the MD-12 is exceptionally economical in operation, using only about 79.5 U.S. gal. of fuel for all four engines per flight hour.

LOT began its postwar domestic operations gradually from scratch on May 6, 1946, when it received 10 Douglas DC-3s together with transport covers it is getting from the Polish air force. Additional aircraft of the two Soviet-built La-2s were subsequently bought

from Russia, the last in 1953, and the carrier plans to phase out all 38's in its service by 1965 at the latest. If the MD-12 flight trials prove satisfactory, they will begin replacing some of the B-14s and La-2s in the near future.

Operating with mostly outdated equipment, limited technical facilities and restricted domestic resources, LOT is having a hard struggle in its attempt to expand. Its fleet B-16 34-passenger transport introduced in April are the only new aircraft in its young fleet of U.S. General 340s and Soviet B-14s and La-2s.

Accident-Free Record

Since the crash of an Il-14 at Vilnius in 1957, no jet passengers were killed and a number of others injured, LOT says it is extremely anxious to avoid this first accident. But it is a high time to



LOT's domestic route pattern has proven profitable thus far.



FIRST POLISH-DESIGNED TRANSPORT since World War II is the four-engine, 20-seat MD-32. Soviet-built aircraft was built by Polish Aeroflot builder. The airplane has been undergoing flight tests since 1958.

get the equipment to enrich our good pilots," one official told Aviation Week.

In order to achieve some degree of operational success as well as for reasons of national prestige, the establishment of a transatlantic network takes top priority in LOT's future plans. Company officials in producing reasons for such an expansion, point to the fact that there are about six million emigrants of Polish origin living in the U.S. and Canada who, they say, would like to fly with LOT to visit their native country and relatives who are still residing in Poland.

LOT has entered preliminary talks with British Overseas Airways Corp. on the possibility of establishing transatlantic service. Discussion has been going on for exploring the possibility of such service in cooperation with BOAC, in which the British airline would operate the flights on behalf of LOT, or be a pooling agreement.

In addition to the three B-14s which in April began serving LOT's semi-international route between Warsaw and Moscow via Vilnius on a three-times-a-week, round-trip basis and also are used for international charter flights, the airline's present fleet comprises four 48-seat General 240s, 12 20-seat B-66s and 18 24-seat La-2s.

Direct Service

In this fall LOT plans to put the B-14s on its short Warsaw-Zurich round-trip route now being served on a three-times-a-week basis by B-14s. In occasional B-14 route extensions to the West and East leave Warsaw via Africa in December and probably to Cairo and Tel Aviv, also are planned for next year. By then, in order to exploit the public potential in peak periods, the present 84-passenger B-14s will have

been converted to 111-seat configurations.

LOT's international network, now across 17 European centers, including Moscow and Vilnius in the Soviet Union. A number of these, particularly East European centers, are operated in pool with CSA, Czechoslovak Airlines, MALEV (Hungary), TAROM (Rumania), East German Lufthansa and VARDIN (Romania).

Domestic Routes

The Polish carrier has only six domestic routes, none of which is seasonal according to LOT because of their close proximity to one another. Consequently, it is not planned to establish an additional domestic route or air

ports for the time being. With the exception of the new international airport at Warsaw-Okęcie, which has three concrete runways—the longest 8,500 ft—only Gdansk out of the six international airports in Poland has two concrete runways. Katowice and Poznan have one concrete runway each. The remaining—Wroclaw, Szczecin and Rzeszów—have grass strips only.

A contributing factor to the loss of service on the airline's domestic network is the low fares charged within Poland, the lowest of any in Europe, and one LOT official. One example quoted in 57.20 per passenger for the approximately 150-mile flight from Warsaw to Poznan at Warsaw to Katowice 240s currently serve most of



INTERNATIONAL ROUTES center on Warsaw and link most major European capitals. East Berlin and Budapest serve as secondary terminal points.



LOT 4-14 AIRLINER: deploys passengers at the airport's main field, Warsaw-Okęcie. The center operator 12 of this craft.

LOT's largest international routes with the exception of the Warsaw-Moscow 11-15 flight. The Conquest operates from Warsaw to Port Beira in Amsterdam and via East Berlin to London, each on a three-times-a-week roundtrip. Last October membership services include Warsaw to Paris via East Berlin, four times weekly. Warsaw, Vienna, Rome, twice a week. Warsaw, Budapest, Belgrade, Athens, twice a week.

The 11-14, some of which are also to be converted from their present 26-passenger to 25-seat configuration, serve LOT's East European network, as well as Brussels, Copenhagen and Zurich at the West at the following frequencies: Prague twice a week, Budapest and Belgrade once a week, Budapest and Sofia twice a week, Copenhagen four times, East Berlin and Helsinki three times and Zurich three times a week.

Domestic Routes

11-15s are also run on the domestic route structure from Warsaw to Gdansk (Danzig) on a three-times-a-week basis. Warsaw to Katowice twice a week, Warsaw to Wroclaw (Breslau) twice, and Warsaw to Szczecin (Stettin), Poznan and Rzeszow each on a once-a-week roundtrip frequency. During peak periods up to eight La-2 relief aircraft also operate on the domestic network. The remaining La-2 fleet comes out special assignments including air support for the government and for a growing number of private enterprises throughout the country on a part-time basis.

The carrier, however, does not follow

the usual practice of most state-owned East European airlines such as Rumania's Aeroflot and CSA, Czechoslovakia's Avia lines, which, in addition to normal passenger transport operations undertake air ambulance, crop dusting or fire-fighting duties. Air service missions are conducted by the Red Cross under the auspices of the Polish Ministry of Health, and the Polish army clubs are responsible for business connected with agriculture or skydiving activities.

Crew Makeup

The LOT 11-15 crew consists of a pilot and copilot, an engineer, radio operator, navigator and two or sometimes three hostesses: the Conquest 340s have a pilot and copilot, an engineer and two hostesses, the 11-14s a pilot and copilot, radio operator and hostess on short-haul and, on longer services, a flight engineer. Crew of the La-2 in charter a pilot, copilot and radio operator, but plans call for elimination of the radio operator.

Utilization rate of the 11-15s has not yet been determined, but LOT hopes that it will approach 1,000 to 1,300 flight hours yearly or about 7 1/2 days. The Conquest 340s and 11-14s are in the air between 180 and 150 hr a month or about 1,200 to 1,400 hr a year. The La-2, chiefly because of the short legs they serve, tend to average between 80 and 100 hr a month.

Maintenance and overhaul of the various types are carried out on the factory's own facilities.

• **Prepresents of the 11-18 are serviced after first 50 and then 100 flight hr**

with major engine overhaul after 100 hr. • **11-18 airframes receive first check after 50 second after 100 and major overhaul after 2,000 hr**

• **Conquest 340 engines are serviced on a progressive basis after 10, 100 and 500 flight hours, which keeps them grounded for one, two and three to four days respectively.** Major overhaul takes place after every 1,500 flight hours, then the engine begins work. Major overhauls take an average about 10 days.

• **Conquest 240 airframes receive first check after the first 50, the second after 100 flight hours, requiring one and two days in each case. The time of progressive overhaul is worked in right stages, major overhauls taking between 10 and 90 days after every 1,500 hr**

• **11-14 prepayments are serviced after 50 and 100 hr, landing in each case, one and two days. LOT has three different models of 11-14 180-212 engines so that, according to their age, major overhauls are carried out after every 500, 700 or 8,000 flight hours which takes up to 20 days. Exchange of engines takes six days each**

• **11-14 airframes are serviced after every 50, 100, 200, 1,000 and 2,000 hr, major overhaul after 4,000 hr. This is required for each of these checks a one, two, six, 20 and 40 days respectively. The 11-15s now in service were bought between 1954 and 1958, some of them have logged 4,000 flight hr to this day.**

• **La-2 engines are checked after every 10 and 50 hr, being one and two days in each case. Major overhaul after every 700 flight hours taking 20 days**

• **La-2 airframes are serviced after 50,**

100, 300 and 600 hr, major overhaul after every 1,500 hr, requiring one, two three to six to seven days and 28 to 5 months respectively.

LOT's total civil working pilots and air hostesses numbers about 1,500 at the moment. Many of the airline's 62 pilots and mechanics and other skilled personnel served with the Polish air force and/or RAF during World War II. For example, 60-year-old Stanislaw Potowicki, head of the Polish carrier's pilot training center at Warsaw Okęcie Airport, performed distinguished service as a first pilot between England and Canada during World War II. Before, he had logged more than 17,500 hours in flying, is a pilot for LOT. He returned to his former job with due respect, as soon as it returned operations after hostilities ended. During his 12-year career with LOT, and including his wartime service, he has flown more than 3.8 million mi.

Most new pilots are drawn from the Polish air force, others from army clubs. Before joining the carrier, prospective pilots must have completed at least 500 flight hours and 50 hr simulator time.

Before LOT pilots, they receive a minimum of 800 to 1,000 hr additional theoretical instruction, 25-50 flight hours training and 20 hr on the firm's Link trainer before they qualify for service as copilot.

An additional 1,500 to 2,000 op-



Viscount in New Uniform

Viscon Viscounts formerly belonging to Capital Airlines are beginning to appear in colors of Poland's flag, after extensive studies and experiments by Capital (AM Feb. 6 p. 39). United acquired 41 of the long-range airplanes when Capital was merged with it. They are being modified one at a time.

first flight hours are then required before they graduate from cockpit to first pilot duties. To enable them to handle the more sophisticated 11-15s, pilots must undergo further theoretical and practical training of up to 100 hr in Russia. One pilot serving with LOT also is scheduled to a 7 to 10 hr flight in a Link trainer simulator before a visit to the airport and field.

Despite its first position strength in overall civil air and its present frustration due to limited resources, LOT is making some progress, if slowly. Compared with a total of 155,000 passengers and 13,000 1/2 tons of cargo carried in 1959, 200,000 passengers and more than 5,000 1/2 tons of freight was transported in 1960. International service, except under a detour to Vienna on LOT's domestic network, 1,121 routes in 1960, domestic network, at Warsaw Okęcie Airport to total 1,265. A comparative figure for 1959 is not available. LOT says it is determined by success in gross passenger ton-kilometers with a corresponding increase in income in 1961.

Two foreign carriers serve the Polish capital on regular scheduled flights: British European Airways, Air France, Sabena, KLM, Royal Dutch Airlines, Scandinavian Airlines, Swissair, Austrian Airlines, CSA, Czechoslovak Airlines, Aeroflot and MAI PV, Hungarian Air Transport.

Equipment now on traffic control equipment are installed at Warsaw Airport and a new precision radio approach device will soon be added. The current situation about seven and a half miles from the center of Warsaw, but actual its purpose was not, it came into service in November 1955, but facilities are now limited and LOT wishes the new network of radio navigation equipment in order to meet urgent transport aircraft requirements. Therefore, it plans next year to begin

comparing its present reception center, looking after restaurant and information facilities. Until now they have been used for combined domestic and international operations, but now and made more spacious buildings to be constructed will suit international traffic while the other facilities will continue to be used for domestic service. Warsaw Airport's air 5,600 ft, main area will be extended to 9,140 ft.

Step with this report modernization and reconstruction program, new domestic passenger to be built at its, the airport home, both the LOT's terminal and local offices, which have been located in two separate buildings in the city center.

LOT, with an initial call of a low four-seat, Eastern 11-15, and four-seat, Czech Airlines, aircraft, some have to extend both its domestic and international network. Gradually, night-transporter, Fokker F.VIII, began to replace the older Conquest 340s. The first Fokker VII 100 aircraft, built under license in Poland were added to the LOT fleet in 1955, the first Polish-designed and built radio-gauge, P70S, 24-hour aircraft were introduced as the carrier's domestic carrier.

LOT continued to develop its network, and, parallel with this development, to modernize its equipment. Two-engine, Fokker DC 3 was purchased on LOT's order on Nov. 1, 1955 and these were followed in rapid succession by Lockheed 104A Electra and 141E Super Electra Super Electra, the first in its engine capacity of Polish design. The ZPL-40 Wicher were part-time service by LOT.

World War II destroyed LOT's beginning and future prospects. LOT's personnel, pilots and equipment were sent abroad in 1939, and equipment was sent abroad in 1940, and equipment was sent abroad in 1941. In 1945, with the former carriers again in service as hostesses, ended and a semblance of order was restored in Poland.

Hughes' Jet Financing Hindrance Charged

New York—Delays and hindrance to the order for turbofan-powered Boeing 707s and for future orders for short-range jet transports like the Sud Caravelle charged last week, as a key factor in *Trans World Airlines' suit against Howard Hughes*.

The suit, filed in U.S. District Court here June 18 but not yet set for trial, alleged violations of the Sherman and Clayton Antitrust Acts on the part of Hughes and two other defendants—Hughes Tool Co. and Raymond M. Holsley, Hughes' representative in the three-man ruling partnership for the Hughes 707-TWA stock holding.

Atlas Corp. and Northeast Airlines are not named as defendants but, partly because of a proposal for merger with Northwest which TWA described as disadvantageous to itself, they are named as co-defendants. Atlas owns 80% of Northwest and Hughes 11% of Atlas.

Besides seeking \$100 million in triple damages for alleged anti-trust violations specified in two suits and \$15 million compensatory damages, the suit on a diversity plan, punitive and exemplary damages the court might decide just the suit also seeks.

- Damages to defendants of all in suit in TWA stock.
- Perpetual injunction against the defendants as any employer or against them attempting to exercise direct or indirect control over TWA.

- Perpetual injunction against the defendants to restrain them from TWA or its management for failure to act in the manner sought by the Hughes' interest or any act not favored by Hughes.
- Perpetual injunction against future acts requiring or hindering TWA stock.

- Perpetual injunction against interfering with, obstructing or harassing TWA or its management.

Treasury injunction also was specified, and obtaining such an order might be as early effort by TWA if it felt there is continued hindrance to its management order.

TWA ordered 20 707-119s and its 707-119s in May, dependent on TWA financing. SIFT ceiling of the \$125 million total cost (AW May 5, p. 36). Negotiations were under way, with more as into the same group participating in TWA's financing last year but with the aid of the Federal Insurance Co.

to the contributors per se was considered—Equitable Life Assurance Society and Metropolitan Life Insurance Co.

Shortly afterward, Hughes attacked the validity of the Boeing order, and the validity of the contract, last (AW June 5, p. 61) and raised the question of TWA's liability for purchase of 41 Boeing 707s on order by Hughes Tool Co.

As a result of such maneuvers, the TWA not alleged, "at least one of the proposed financing has completely withdrawn all negotiations for the proposed financing, and TWA's efforts to obtain such financing have been handicapped."

The 707 order still is firm, despite the financing problem. A possible TWA General order is another reason. In filing the alleged injury, the complaint asks for an order to force the Boeing order have been imposed then added.

TWA's ability at this time may be under additional jet-powered aircraft which it regularly needs has been hand-

icapped. The date when additional jet-powered aircraft will be available to and will be in use by TWA has been delayed.

The complaint alleges a pattern of inefficient dating back in 1958, but for the most part deals with the period beginning in 1955 when jet transport orders were becoming a reality. Recall the complaint alleges the Hughes group conspired and conspired to obstruct the Boeing 707 to rely on a jet aircraft financing, providing such financing only if aircraft were acquired from Hughes Tool, and forcing TWA to become direct suppliers.

Also cited is the question of attempts to restrain domestic and foreign commerce through control of TWA as a substantial supplier of an transportation. In effect, this tends to make loans to the public as well as private require an order.

Prior to 1955, the complaint says, Hughes and General Dynamics Corp. conspired to develop a jet transport known as the Model 35, for which TWA would supply a "substantial amount." After the time the Model 35 was dropped—October, 1955—Pan American World Airways, a general competitor of TWA, placed the first jet order with a U.S. manufacturer, the complaint says.

While other orders followed with jet orders, through early 1956, Hughes developed a plan for Hughes Tool to manufacture an aircraft called the Golden Arrow, which at that time also was dropped.

In the meantime Hughes Tool ordered 15 Boeing 707-131s, and 18 Boeing 707-131s and renewed negotiations with General Dynamics which resulted in orders for 30 aircraft eventually known as the Boeing 680 Super, later the Golden Arrow, finally at General 582.

Hughes Tool reserved the right as its purchase contracts with the manufacturers to assign TWA the aircraft, but the complaint alleged, refused despite repeated requests between 1956 and 1960 to assign TWA the right to acquire these aircraft. In June, 1960, the complaint continues, Hughes ordered 60 707s to Pan American.

During this same period, Hughes requested TWA to make modifications at the 582, the complaint said, but prevented TWA from assigning for design modifications or repair.

Jet aircraft were made available to TWA on a day-to-day basis from 1959 and 1960, the complaint said, but these were inadequate to TWA's needs and the losses sustained TWA from declining such orders, the complaint says.

By 1960 the merger proposal with Northwest had been made, and in November Hughes Tool refused an offer



First of Heathfield Trident Transport Rolls Out

First of Heathfield Trident Transport rolls out last week was rolled out at the Heathfield plant, about one month ahead of schedule. Trident, whose direct competitor is the Boeing 727, will start its flight testing this winter. Pan Am has three all-metallic Boeing 707s on order at \$100 million. First cost (AW June 5, p. 36). British European Airways has ordered 24 Tridents for test-to-order-lease basis. Initial batch of seven is scheduled for the Heathfield production line. Cost is viable in background.

in 180 orders to Northwest, including three aircraft Hughes Tool had assigned to TWA be approached in May, the complaint said.

The Hughes group and Atlas Corp., the petition alleged, had earlier caused Northwest to suspend a major project to TWA on terms which were disadvantageous to TWA but advantageous to Northwest in order to:

- Enlarge TWA's requirements for new aircraft, and thereby, to enlarge the demand in the market from which the defendants had benefited and would continue to benefit in all other respects.

- Enable Atlas to obtain stock of TWA on terms advantageous to Atlas and its stockholders, including Howard Hughes.

After its new management took over TWA began to take a new look at the merger project but not completely dropping the Northwest deal (AW May 15, p. 52). Hughes and Atlas have continued to demand TWA accept the merger on the present terms, however, the complaint says.

The complaint takes up the financing problems of TWA, charging that the Hughes group refused to let TWA engage in equity financing unless Hughes Tool was allowed to increase its equity position in the airline. TWA then was forced to depend on the Hughes group for financing, the complaint said. Because of delay in obtaining the financing program to which Hughes eventually agreed last year (AW Feb. 9, p. 38), TWA and 51% owned TWA's financial loss of \$15.6 million in 1960 for losses and lost opportunities for only minor of substantial losses.

transport aircraft the complaint said. TWA's financing plan included a \$100-million debt issue, some, which was offered to stockholders through rights issued on the basis of common stock held. The debt was placed on the market in May, about the time TWA received its new jet order and was negotiating to finance it. During this period the complaint said, the Hughes group:

- Attempted to secure TWA via new changes the General 582 from Hughes Tool instead, asserting that TWA might have an obligation to bar the General airplane, that the Boeing or de Havilland jet in TWA's best interest, and threatening suit against TWA in reliance and damages to the airline, the directors, flying licenses and firm credit institutions.

A Warrant issued in its contact with TWA was not set for trial.

- Based objections with the Securities and Exchange Commission as to the debt issue as to transfer proceeds.

TWA Losses

Trans World Airlines lost \$15,724,000 after its credit during the last six months of this year, compared with a \$4,000 profit for the same period at 1960. June 1961 net profit was \$547,000, down from \$4,000,000 for June 1960. TWA's annual \$1,614,000 loss available last year during the last half of 1960, less \$27,747,000 losses income tax losses. Annual payments last year of about \$5.65 to \$15.15.

Hughes Asks Dismissal, Resists Appearance

Hughes Tool Co. replied to the TWA antitrust suit last week with a motion to dismiss, controlling that dealings of Hughes Tool with TWA were exempt from suit approved by the Civil Aviation Board, thus exempting them from the antitrust laws even if applicable.

Charles C. Davis, general counsel for Hughes Tool, filed a supporting affidavit, asserting that the proposed loss of TWA's jet order was not competitive and was all serving in the public interest as it was an attempt to perpetuate the wrong test beyond the transaction originally agreed upon.

Initial steps in the suit but were chosen by TWA to a suit on a court order to require Hughes to provide to give depositions, and the permission by both sides of affidavits for taking of depositions of other parties and witnesses.

John F. Swartz, a partner of Cadell, Gordon, Roswell & O'Brien, attorneys representing TWA at the most proceedings told Federal Judge William B. Ewald in U.S. District Court, Southern District of New York, that he wants to examine Howard Hughes in person on the witness stand as Hughes will be represented by grown men testimony. Davis replied that Hughes Tool would have other equally representative men give more testimony, but that Hughes does not want to testify because he prefers not to appear in public.

"The man is an eccentric," Davis told the court, "but that's no reason for taking away his property."



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Chris D. McKeen

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highways coast. The computer records the message and then checks the following points:

- That the paper number of message characters have been included.
- That the message format conforms with established standards and whether additional messages are forthcoming.
- That time interval between the arrival of the following flight and departure of the preceding flight is equal to or exceeds prescribed minimum limits.
- That the receiving flight operates between cities specified and that the following flight operates from the boarding point specified.
- That both receiving and following flights operate on the day of the week or date of the month specified and that space is available on the receiving flight and the sale is acceptable.
- That the transaction is not a duplicate.

Upon completion of these checks, the computer transmits to the telephone connected with the telephone a voice message. The computer then stores the passenger's name, flight and date converts the record to the particular format of the receiving airline and transmits a booking message to the boarding point or Teletype switching center of the receiving airline.

South American Route Investigation Ordered

Washington—Civil Aeronautics Board last week ordered an investigation to determine whether U. S. carrier competition in South America should be reduced by ending or curtailing certificates now held by Pan American, TWA and Delta airlines.

The order is based on a Board study of the South American route structure which concluded that U. S. South American traffic needs can best be met by a balanced route structure providing for two carriers which separately cover the east and west coasts of the continent, or non-competing except at Buenos Aires and provide service to U. S. gateways primarily west.

In its order, the Board noted that lower charges in technology and service patterns have occurred since the early 1950s when the route was established in the South American area. It said that in 1944, Pan American and TWA opened in competition with three South American carriers, while Delta, U. S. South American carrier, was authorized to serve the U. S. market.

CAB ordered hearings in the case and decided that the proceedings be conducted in two separate phases, one dealing with the route pattern to be established, the second with the selection of the carrier or carriers to serve such routes.

Hijacking of Pan American DC-8 Spurs Action on Preventive Bills

By Robert H. Cook

Washington—Government considers new a meeting word of aerial hijacking was underscored by the diversion of a Pan American World Airways DC-8 to Cuba last week as Congress moved to adopt new position and President Kennedy called for preventive measures.

The President warned against becoming "over-zealous" about the incidents claiming that a "let's-see" kind of approach would be a mistake. In addition to the hijacking on the DC-8, the President asked airlines to strengthen cockpit doors and keep them locked with keys held only by the crew in the cockpit.

The Pan American DC-8, with 71 passengers and three crewmen, was seized in Cuba after reports from the State Department, the Mexican government and the airline. Cuban authorities seized the hijacker, identified as Albert C. Galt, a 27-year-old domestic agent from Miami. He reportedly claimed to state the Pan American flight to go to Washington, D.C., to see the Algerian situation. Galt will be charged with crimes on the high seas, according to the FBI.

En route, to Guatemala and Panama from Mexico City, the DC-8 was commandeered shortly after takeoff, airline spokesman said. Unable to contact the regular flight, the DC-8 was diverted to a two-hour stop at a nearby airport, then landing, the pilot asked course and landed at the Cuban capital.

About the time the Pan American aircraft was landing in Havana, anti-Cuban Cubans were attempting to hijack a Cuban DC-1 in near from Havana to the U. S. gate.

Meanwhile, the State Department received a report from Cuba on an earlier hijacking in Washington, D.C. The hijacking was reported to the State Department by the Cuban Embassy in Havana. The report noted that the hijacking was reported to the State Department by the Cuban Embassy in Havana.

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Capture of the DC-8 brought new demands for congressional action to curb further hijacking incidents, and it was expected to accelerate the passage of new legislation designed to impose a life sentence for this type of crime. The Federal Aviation Agency, which earlier endorsed the arrest of hijacking pilots and other preventive measures, has backed a Senate measure on hijacking penalties and several Senate bills are before a House aviation subcommittee.

Airlines have quickly adopted a new set of measures on cockpit doors, ranging from locking the cockpit door to ensuring armed guards. Most carriers also noted that the possible danger to aircraft and passengers might be reduced by preventing pilots to be seized. These rules would be enforced by ALPA.

Pan American and a law on place to control its two-day round trip between Miami and Havana. Delta Air Lines, which operates one trip a week through Havana, also said it expects to attack the Senate.

Senate passed an "act of violence" bill introduced by Sen. Chris Engel (D-Calif.) last last week. The bill makes it a federal violation to introduce, assault or interfere in any manner with flight crew and calls for a \$10,000 fine or imprisonment for 20 yr., or both.

If a dangerous weapon is used, the possible could be higher. The bill also makes it a federal violation to interfere with the carrying of an armed weapon on an aircraft a crime punishable by a fine of \$1,000 or one year in prison, or both, for the hijacking of aircraft transports to be judged under current laws and penalties covering piracy on the high seas.

Adoption of a House bill also, to be delayed by complex legal issues involving state versus federal jurisdiction.

The Pan American hijacking was the first such incident since Nov. 1, when a National Airlines flight was forced to land in Havana. The aircraft was later released. On Feb. 24, an Eastern Air Lines Lockheed L-1049 was commandeered and forced to land in Havana.

One week later an attempt to hijack a Pacific Air Lines DC-7 failed and the captain, in return action and a passenger were wounded by the armed hijacker.

Confidential sources recently noted losses a Boeing 707, which was commandeered shortly after the transport took off from a flight from San Francisco to Los Angeles. The aircraft was forced to land in Los Angeles. The hijacking was reported to the State Department by the Cuban Embassy in Havana.

J60



WHAT WILL THIS VERSATILE TURBOJET DO NEXT?

Pratt & Whitney Aircraft's J60(JT12) jet engine, which weighs only 436 pounds yet produces 3,000 pounds of thrust, has demonstrated its versatility in a broad range of applications.

For the United States military forces, it powers the T-39 twin-engine trainer, the C-140 four-engine utility transport, and the SO-6 reconnaissance drone. It supplies power for the Canadian Air Force CL-41 single-engine trainer. The world's fastest executive transport uses the J60 which also has been ordered for a West German high altitude research glider.

Add a free turbine, and the J60 becomes a turboshaft engine, developing 4,050 shaft horsepower. Two of these turboshaft engines will give advanced helicopters power to lift nine tons. This version of the J60 is also projected for VTOL aircraft.

A modified J60 for industrial uses will supply power for pumps, compressors, electric generators—and can be adapted for use in ships and heavy earth-moving vehicles.

Whatever its application, the J60's simple, rugged design ensures high reliability and easy maintenance.

Pratt & Whitney Aircraft

Division of UNITED AIRCRAFT CORPORATION
Bridgewater, Connecticut



Airline Traffic—June 1961

	Revenue Passenger Miles	Revenue Passenger Miles (000)	Passenger Load Factor %	U. S. Mail Ton Miles	Revenue Ton Miles	Flight Ton Miles	Total Revenue Ton Miles	Overseas Load Factor %	
DOMESTIC TRAFFIC									
American	723,306	597,328	82.7	9,879,340	847,932	11,042,148	40,370,377	38.5	
Boac	184,420	76,761	41.7	283,430	179,312	926,277	10,187,863	44.3	
Continental	123,110	65,799	53.5	234,136	117,867	756,761	8,882,260	46.6	
Delta	374,149	188,147	50.3	436,244	362,808	1,258,114	16,448,377	31.1	
Eastern	794,269	351,933	44.3	1,268,891	315,536	3,478,849	38,936,833	43.3	
Northwest	143,130	73,360	51.2	286,432	17,514	176,512	18,432,466	46.6	
Trans World	482,655	400,847	83.3	1,339,486	739,333	3,168,636	40,841,151	39.4	
United	1,061,475	719,281	68.5	4,739,617	1,866,437	8,471,112	84,877,421	33.6	
Western	160,213	76,350	47.6	293,440	150,460	379,121	5,617,843	47.9	
INTERNATIONAL									
American	8,244	7,179	87.2	6,470	722	315,227	5,676,222	44.4	
Boac	8,712	13,326	153.3	46,337	167,960	5,441,498	16,441,498	44.6	
Continental	33,447	2,331	6.9	3,449	7,193	798,623	67,9	67.9	
Delta	1,432	4,264	297.2	1,612	4,707	221,729	44.3	44.3	
Eastern	47,223	47,703	101.1	138,310	435,207	7,983,066	37.3	37.3	
Northwest	18,372	1,737	9.4	186	4,416	194,716	48.9	48.9	
Trans World	7,483	8,140	108.8	16,430	4,527	317,280	1,579,887	44.8	
United	187,761	341,861	181.8	3,475,336	6,286,141	22,409,179	67.9	67.9	
Western	115,763	175,898	151.9	598,567	6,497,509	39,876,984	53.3	53.3	
Boac	47,243	172,313	364.6	3,291,261	12,799	2,840,938	26,31,466	67.9	67.9
Continental	15,276	16,100	105.4	95,304	444,343	2,494,266	37.4	37.4	
Delta	1,432	4,264	297.2	1,612	4,707	221,729	44.3	44.3	
Eastern	11,402	17,703	155.3	3,215,710	3,607,316	1,747,934	73.3	73.3	
Trans World	25,428	115,420	45.4	217,494	1,651,441	14,896,348	47.3	47.3	
United	21,083	23,076	109.5	217,494	1,651,441	14,896,348	47.3	47.3	
Western	8,169	7,719	93.2	10,640	34,776	805,613	48.8	48.8	
LOCAL SERVICE									
American	8,113	7,466	92.0	34,431	31,065	76,146	1,899,346	31.3	31.3
Boac	16,185	27,300	168.8	1,700	3,278	12,723	16,441,498	44.6	44.6
Continental	27,120	4,210	15.5	15,761	8,479	21,724	430,141	26.4	26.4
Delta	23,320	9,766	42.3	38,178	31,917	68,816	797,216	46.8	46.8
Eastern	76,097	14,594	19.2	34,178	34,178	1,210,457	42.9	42.9	
Northwest	36,413	18,020	49.5	46,297	30,497	71,323	1,443,191	40.6	40.6
Trans World	25,428	9,346	36.8	21,363	25,498	36,416	796,156	30.7	30.7
United	42,776	8,948	20.9	14,161	4,588	19,749	292,347	36.8	36.8
Western	46,740	16,844	36.2	15,208	17,271	23,126	1,618,638	21.6	21.6
Boac	15,176	4,471	29.5	23,712	14,481	27,866	446,168	27.4	27.4
Continental	21,726	4,247	19.5	30,763	12,616	6,919	1,018,638	27.4	27.4
Delta	21,726	4,471	20.6	15,208	17,271	23,126	1,618,638	21.6	21.6
Eastern	21,726	4,471	20.6	15,208	17,271	23,126	1,618,638	21.6	21.6
Northwest	21,726	4,471	20.6	15,208	17,271	23,126	1,618,638	21.6	21.6
Trans World	21,726	4,471	20.6	15,208	17,271	23,126	1,618,638	21.6	21.6
United	21,726	4,471	20.6	15,208	17,271	23,126	1,618,638	21.6	21.6
Western	21,726	4,471	20.6	15,208	17,271	23,126	1,618,638	21.6	21.6
RAILROAD LINES									
American	23,477	6,664	28.4	9,799	5,804	411,261	31.4	31.4	
Boac	46,350	6,932	14.9	4,469	136,347	715,371	40.3	40.3	
CARGO LINES									
American	3,349	30,809	91.9	91,430	38,392	212,684	232,888	31.7	31.7
Boac	8,446	24,374	28.9	31,430	38,392	4,742,310	16,376,210	70.3	70.3
Continental	3,349	30,809	91.9	91,430	38,392	212,684	232,888	31.7	31.7
Delta	8,446	24,374	28.9	31,430	38,392	4,742,310	16,376,210	70.3	70.3
Eastern	3,349	30,809	91.9	91,430	38,392	212,684	232,888	31.7	31.7
Northwest	3,349	30,809	91.9	91,430	38,392	212,684	232,888	31.7	31.7
Trans World	3,349	30,809	91.9	91,430	38,392	212,684	232,888	31.7	31.7
United	3,349	30,809	91.9	91,430	38,392	212,684	232,888	31.7	31.7
Western	3,349	30,809	91.9	91,430	38,392	212,684	232,888	31.7	31.7
RECREATION LINES									
American	23,477	6,664	28.4	9,799	5,804	411,261	31.4	31.4	
Boac	46,350	6,932	14.9	4,469	136,347	715,371	40.3	40.3	
Continental	3,349	30,809	91.9	91,430	38,392	212,684	232,888	31.7	31.7
Delta	8,446	24,374	28.9	31,430	38,392	4,742,310	16,376,210	70.3	70.3
Eastern	3,349	30,809	91.9	91,430	38,392	212,684	232,888	31.7	31.7
Northwest	3,349	30,809	91.9	91,430	38,392	212,684	232,888	31.7	31.7
Trans World	3,349	30,809	91.9	91,430	38,392	212,684	232,888	31.7	31.7
United	3,349	30,809	91.9	91,430	38,392	212,684	232,888	31.7	31.7
Western	3,349	30,809	91.9	91,430	38,392	212,684	232,888	31.7	31.7
AGENCY LINES									
American	8,369	602	7.2	2,391	4,106	71,199	48.3	48.3	
Boac	2,824	281	10.3	2,824	281	101,728	50.3	50.3	
Continental	4,106	361	8.8	2,391	4,106	71,199	48.3	48.3	
Delta	1,432	89	6.2	490	1,197	11,891	27.4	27.4	
Eastern	4,242	1,422	33.5	38,611	121,127	1,018,638	18.9	18.9	
Northwest	14,813	15,079	101.8	148,628	1,321	2,247,216	73.1	73.1	
Trans World	1,402	1,442	103.0	28,270	188,148	896,389	48.3	48.3	
United	1,402	1,442	103.0	28,270	188,148	896,389	48.3	48.3	
Western	1,402	1,442	103.0	28,270	188,148	896,389	48.3	48.3	
Boac	1,402	1,442	103.0	28,270	188,148	896,389	48.3	48.3	
Continental	1,402	1,442	103.0	28,270	188,148	896,389	48.3	48.3	
Delta	1,402	1,442	103.0	28,270	188,148	896,389	48.3	48.3	
Eastern	1,402	1,442	103.0	28,270	188,148	896,389	48.3	48.3	
Northwest	1,402	1,442	103.0	28,270	188,148	896,389	48.3	48.3	
Trans World	1,402	1,442	103.0	28,270	188,148	896,389	48.3	48.3	
United	1,402	1,442	103.0	28,270	188,148	896,389	48.3	48.3	
Western	1,402	1,442	103.0	28,270	188,148	896,389	48.3	48.3	

Note: For American, Northwest, Delta, Continental, Eastern, Trans World, United, and Western, data are available for the period ending June 30, 1961. For Boac, data are available for the period ending June 30, 1961.

Four ways to tell a true airlifter



1. Loads from the rear



2. Truck-bed height



3. Parachutes big equipment



4. Lands on short, rough fields



A true airlifter is a special breed of bird—built without compromise for its special kind of work. Huge rear doors allow cargo to be loaded straight in. Cargo floor is truck-bed height; no hoisting cargo up and jockeying it around corners. Rear doors can be opened in flight for bulldozer-size parachutes. And a true airlifter need not be pampered with paving. It lands and takes off in sand and rough dirt, close to the action, just like a bush plane. Lockheed's C-130 Hercules project is the true airlifter. Now in its second million miles of operation, 14 different versions are flying or being built for the U.S. Air Force, Navy, Marines, and Coast Guard—and for the air forces of Canada, Australia, and Indonesia. Newest model, C-130E, will soon haul huge cargoes on MATS' worldwide routes. The big Lockheed/Georgia cargo jets of the future will be true airlifters, too; they will have the same four basic attributes Hercules has.



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AIRLINE OBSERVER

►Airbus reports the Pratt & Whitney JT3D turbofan engine has no one in "oil only" problem. For reasons still unknown, the engine will begin to throw oil and rapidly exhaust the oil and fuel supply. No engine damage has resulted, since the combination of oil pressure warning light and visual check by oil running out the breather pipe at the bottom of the nacelle has brought in-flight shut-down. It is seen as a concern that a safety problem since engine removal usually results, followed by inspection that have disclosed nothing. The oil itself is very expensive. Pratt & Whitney Boeing and Sukhoi, the available manufacturers, are waiting on a fix. Airbus is looking at the nacelle as being studied as a source of temporary shut-down of an oil seal, which occurs itself when the heat is removed leaving no clear in the leak.

►United Air Lines is rapidly disposing of jet-engine aircraft inherited from Capital Airlines in a result of the merger of the two companies. So far, United has sold 10 Douglas DC-8s, five Lockheed L-1049 Constellation and two DC-3s.

►Eastern Air Lines is endorsing the popularity of its Washington New York-Boston commuter service but is ready to see the low cost but to highly dependable performance. The carrier has found that many regular passengers on the high-density route are willing to take the traffic since because of cost loading and unloading, frequency of schedules and a non-stop service on their route.

►Cracked engine nacelles due to high temperatures reportedly are the main reason why all B-1B tail-fuselage transports in service were grounded and flown back to Missouri for modification following an Aeroflot B-1B crash last summer (AW Aug. 25, 1980, p. 45). Since then, CSA Czechoslovak Airlines has lost two B-1Bs—one at Funchal, Goazaria, in March and one at Comblance in June. After according to since B-1B operation, the modifications introduced in Missouri last summer solved the engine-nacelle design problem.

►Sen. A. S. Miler (Minnesota) (D-Minn.) has asked the State Department, Civil Aeronautics Board and Federal Aviation Agency to get on one page with respect to the negotiation of international bilateral air transport agreements. Sen. Miler said that "too international passenger agreements are enough of a race without duplicating the confusion in the cockpit on the face of an operator to create a national crisis."

►Federal Aviation Agency will install visual glide slope indicator lights at 37 airports following first delivery of the units in September. Systems developed by the Federal Aeronautics Establishment, consist of 12 light units arranged in three rows but set on each side of the runway. Lights can be seen in daytime and under limited visibility conditions as well as at night.

►Dutch government has told the State Department it will protect air Civil Aeronautics Board attempt to rule on KLM's request for West Coast landing rights. The Dutch held that 30 M. 1000 flying rights in the U.S. were established in the 1957 bilateral air transport agreement between the U.S. and The Netherlands, and that the CAA has no jurisdiction over such agreements.

►British Overseas Airways Corp. agreed again on Air Transport Licensing Board transatlantic route grant to Grand Eagle Airlines (AW July 31, p. 45) will take a day in the summer's transatlantic air traffic. BOAC will claim that the poor results that year indicate that forecasts on which the Board's decision was based are likely to prove over-optimistic. Hearing has been set for Sept. 26.

►Bilateral air transport agreement has been signed between the Iraqi Republic and Poland for direct Baghdad-Warsaw air service.

SHORTLINES

►Alitalia reports a net profit of \$178,151 for its international operations during 1980. The Italian airline's 1980 revenues were \$75.5 million, with operating expenses totaling \$66.9 million. The carrier paid \$3.2 million in taxes and other costs in 1980.

►American Airlines reports 8,800 passengers have flown this year on its "Brightwing" program, begun last spring at 15 cities.

►British Overseas Airways Corp. will open four new U.S. sales offices: Los Angeles, Aug. 14; Hartford, Conn., Sept. 11; Newark, N.J., Oct. 30; and Honolulu, Nov. 5.

►Eastern Air Lines has begun a testing research program to find improved methods of forecasting high altitude and adverse turbulence.

►El Salvador will expand and modernize its El Salvador International Airport at the capital San Salvador to include a 2,800 ft runway. VGR facilities (gate) indicate and water treatment and sewage. U.S. has loaned \$1.4 million for local construction costs and El Salvador-Transport bank has lent \$2 million for U.S. construction costs.

►KLM Royal Dutch Airlines' "TUC" (Tine Aerial Customer) plan allows shippers to secure, at 1% of shipping costs, against arrival time delays. If a shipment is more than 24 hr late from published charges are refunded.

►National Airlines has begun cargo service from Mexico to Los Angeles via Orlando, Tampa and Houston with two B-747 Super Constellation aircraft, making five round trips a week.

►Polynesian, Washington aviation committee consultants, will conduct a study of aircraft noise for Federal Aviation Agency at selected airports throughout the country. Program will not require and assist authorities in planning new airports and some alternative procedures.

►Southern Airways has purchased for \$100,000 a shortline aircraft from the receiver of \$1 million in convertible debentures. Southern's long-term bank and supplier credit is nearly \$25 million.

►Trans-Texas Airways' first cuts of up to 32% between Dallas and San Antonio have been approved by Civil Aeronautics Board.

TACAN ACCURACY RIGHT OFF THE SHELF



TACAN test equipment from the world's largest maker of airborne TACAN

Hoffman now offers a new and complete line of specialized test equipment necessary to maintain TACAN accuracy in the field—thus insuring the superior performance built into airborne TACAN equipment. Compact and rugged Hoffman simulators are available in standard off-the-shelf items (Federal stock numbers assigned), and at lowest cost. Equipment tests all airborne TACAN models now in use.

HLI-118A (AN-118A-22) Radio Test Set

300MHz portable unit simulates standard power line signals to check accuracy of any model TACAN (with or without) in aircraft, for timing, bearing and identification signals. Also checks power and sensitivity. For details see HLI-118A-22.

HLI-3000 TACAN Receiver Simulator

Simple functions of TACAN or OASD receiver functions to check maintenance and performance capability and check copy on all models. TACAN sets, Federal Stock No. 5405-694-1227.

HLI-100 Adaptive Error Analyzer

Detects and provides visual and recorded indications of static and dynamic fluctuations in both main portion of TACAN sets, being checked by HLI-100.

HLI-118A Pilot Power Calibrator

Measures peak output power of TACAN transmitter in standard without use of calibration charts or auxiliary equipment.

HLI-118A/118A-1/100 100Watt/100W Power Source

Simulates aircraft wiring in testing all AN-118A-22 and other TACAN sets and transmitters removed from the aircraft. Federal Stock No. 5405-125-0100, 5405-125-1112, 5405-125-1117.

Send for complete data file on Hoffman TACAN test equipment and TACAN air navigational systems.

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- Experimental X-band high-temperature magnetron, GR 923
- Reflex Klystron that extends millimeter band coverage to 120 kmc, GRK 931
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New pictures of Russian Beriev Be-6 jet amphibian show additional hull details. Note width of low dorsal—designed to prevent spin ingestion by engines (AW July 17, p. 30). Seen in planform, the Be-6's engines are tucked out from the fuselage at the rear.

Photos Show Added Russian Seaplane, Missile Details



Be-6 has traditional Russian tail-turret configuration. Forward fuselage shows signs of tail-wave damage to paint. Wings have separate dihedral, like the U.S. F-105, permitting wing tip loads to counter water-surface stresses. Horizontal tail appears to have positive dihedral.



Russian Sukhoi Su-26 fighter (top) appears to be carrying jet-boosted type of rocket motor (AW July 24, p. 28, 29, 30). Sukhoi shows a stable configuration with small fin at nose and large triangular fin (left). Platform of air-to-surface missile carried by Russian Su-26 (below) is seen in this new photo showing high sweep wings. Small probes are visible at tips of tail surfaces. Nose of missile-carrying fin is extensively modified for dual rocket.





ACF INDUSTRIES' trainer for F-105D simulates pilot responses throughout mission.

High Degree of Mission Realism Is Feature of F-105D Simulator

Nellis AFB, Nev.—High degree of automation, realism, become of the cockpit, instruments and the F-105D Thunderbolt, has been achieved in a newly installed mission trainer at this combat crew training base.

Built by ACF Electronics Div. of ACF Industries, Inc. the \$1.7 million training device (AW Jan. 2, p. 74) realistically simulates the responses pilots experience throughout missions in the Republic F-105D. Aside from depicting the procedures necessary to accomplish intercept flight in the nuclear equipped fighter-bomber from takeoff to touchdown, the ACF MB-7 trainer provides the pilot with valuable training in weapon delivery techniques and in the operation of the fire control, bombing and navigation computing equipment carried by all-weather fighters (AW Apr. 17, p. 38).

A major feature, achieved for the first time, according to ACF, is the accurate simulation of land-mass relief. Based on reproduction of terrain as the simulator comparable to that received by the North American Search and Rescue Radar (NASARR), the simulator's color function reproduces the ground mapping, contour mapping and terrain avoidance features of the airborne system.

The MB-7 also will reproduce the scope and instrument display com-

responding to what a pilot sees during use of several methods of weapon delivery including high-altitude bombing, glide bombing and low-altitude delivery. These attack maneuvers are accomplished by autopilot or as flown manually with instrument reference in the trainer and as it would be in the actual aircraft. Included are the automatic instrument directed escape maneuvers provided by the automatic flight control system (AFCS) in the aircraft. The simulator also affords the pilot the opportunity to practice the intercept procedures in situations intercept missions employing Sidewinder or other current air-to-air missiles.

Complete profiles of various missions assigned to combat units can be performed by pilots in the MB-7. The radar antenna and features that will be experienced should it ever become necessary to fly the actual mission are accurately simulated. Radar target and route prediction can be accurately reproduced by the radar machine portion of the MB-7 allowing for familiarization and crew synchronization of the proposed combat mission. Pilots will be able to "punch" their assigned mission or allow an instructor to create a mission.

Further adding to the reality of the simulation, the trainer is equipped with multiple, variable-frequency exciters which accurately reproduce output

ADVENT



To create a worldwide communications system, three ADVENT satellites could be spaced equidistantly in an equatorial orbit. Each satellite, orbiting at 7000 mph, could hover in a constant position relative to the Earth, in direct line of sight of approximately one-third of its surface. ADVENT is being developed for at least one year of effective in-orbit operation. General Electric's Missile and Space Vehicle Department is developing and building the ADVENT space craft and the following subsystems:

Tracking and Command to provide position and orbit information.

Propulsion to inject the ADVENT satellite into its correct orbit.

Power to operate the communications and all other equipment—two solar arrays harnessed by several thousand solar power cells, and four storage batteries for operation during eclipse.

Attitude Control to orient ADVENT's solar cell paddles toward the sun and its antenna toward the Earth.

Environmental Control to keep equipment operating at the stable temperature necessary to fulfill the long life requirements.

Telemetry to provide continuous transmission of data on equipment performance.

GEICO, a department of the General Electric Defense Electronics Division is developing the space craft for the U.S. Army ADVENT Program under a contract with the USARF Space Systems Division.

GENERAL ELECTRIC



ADVENT is designed to be America's most advanced military communications system. Three active repeater satellites, orbiting at 22,900 miles in space, can provide instantaneous communications among U.S. government activities throughout the world. To help prove overall system feasibility, General Electric's Missile and Space Vehicle Department is developing the ADVENT space craft for the U.S. Army, under a contract with the U.S. Air Force.

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simulator. In addition to engine and flight instruments, the trainer is equipped with oxygen and environmental systems. All possible sources of in-flight emergencies can be simulated. It familiarizes the pilot with various operating procedures.

In addition to the student pilot is the instructor, a rated pilot in need of an instructor to supply the additional. A technician is employed to assist the contractor pilot.

NCF is building seven of the MR-7 simulators for the Tactical Air Command. This will be installed at F-102 bases in the United States and abroad.

PRODUCTION BRIEFING

Atlantic Research Corp. has a \$250,000 Air Force Flight Test Center contract for research in their A-104 test cell and model engine. Company will work on liquid propellant internal combustion liquid oxidizers and a catalytic fuel to liberate heat along with a third material that is gas flowing.

Aercon-General Corp. has signed a \$5.7 million contract with the National Aeronautics and Space Administration for first-phase development of the Nova nuclear rocket engine. Six-month contract also included a negotiated sub-contract with the Westinghouse Electric Corp. for the reactor portion of the project.

Bell HRL-18 and commercial 47G-18 will be evaluated by the Army during high attack operations at Ft. Belvoir, Ill., which is being supplied to test its early, second-generation advanced, but another trial at Fort Belvoir, Ariz. and the together with Ft. Belvoir, Ariz. will provide Army with additional technical data on performance under extreme conditions for better evaluation of field reports. Bell will provide the 47G-18 to demonstrate capabilities of the latest series of the light helicopter as all the field personnel. The company has completed delivery of previous model 47 (H-11) series order to the service.

Markin Co. received a \$70.7 million Army contract recently to complete the Pennington test program and to begin production of the missile system.

Radcliffe, Inc., Melbourne, Fla., will supply PCM/FM ground telemetry equipment for combat area. Working in the Air Force Materiel program as for a \$700,000 sub-contract from The Boeing Co.

Howards Powder Co., Wilmington, Del., has signed a contract exceeding \$40 million from the Air Force Systems Command's Ballistic Systems Division for continued research and development.



**Taber Transducer logs 1,500,000 cycles
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The accuracy, continuous performance and economy of Taber bonded strain gage pressure transducers are proved in test operations at Aercon Power Media, Inc., a subsidiary of Pail Corporation, Glen Cove, N. Y.

This leading manufacturer of porous stainless filters uses Model 176 Taber Telehydra Pressure Transducers in long-term testing pneumatic and hydraulic filter units for marine, aircraft, and atomic applications. During these tests, pressure pulses from zero to 10,000 psi are received and recorded on an oscilloscope at a rate in excess of 150 cycles per minute. Rate of pressure rise is in the range of 200,000 to 300,000 psi per second. The unit shown above has been in operation in excess of 1½ million cycles without repair or overhaul.

For full information on Taber Transducers (in pressure ranges from 0-50 to 0-10,000 psi) for static, ground support and aerospace applications, send this coupon attached to your letterhead.

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1000 W CARRIER POWER WITH HIGH STABILITY

telegraph A1, telephone A1 and FRK (Radio Teletype). It can be remotely controlled using one pair of telephone lines plus ground return with Aerocom Remote Control Equipment. Front panel switches and microphone are included for local control.

Four crystal-controlled frequencies (plus 2 closely-spaced frequencies) in the 2.0 - 24.0 megacycle range can be used one at a time, with channeling time only two seconds. Operation into either balanced or unbalanced loads. The power supply required is nominal 230 volts, 50 - 60 cycles, single phase.

The housing is a fully enclosed rack cabinet of welded steel, force-ventilated through electrostatic filter on rear door.

Telegraph keying (A1): Up to 300 words per minute Model 1000 M Modulator (mounts in trans-

mitter cabinet) is used for telephone transmission, a compression circuit permits the use of high average modulation without over-modulation. Model 400-4 Channel exciter is used for FRK.

Output connections consist of 4 insulated terminals (for Mercoid antennas) and 4 coaxial fittings Type 80-308, which can be used separately or in parallel in any combination. For 800 ohm balanced load, Model TLM matching network is used, one for each transmitter channel.

As in all Aerocom products, the quality and workmanship of Model 1046 are of the highest. All components are conservatively rated. Replacement parts are always available for all Aerocom equipment.

Complete technical data on Aerocom Model 1046 available on request.



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work on the third stage popovers and for the solid-pipe/air Mountview environmental failure tests. Contract also calls for delivery of flight test station for the Mountview R&D program at Cape Canaveral.

Boring Co. and Catalytic Co. structures Co. are joint owners of a contract from General Dynamics/Aeromarine to install environmental facilities to assure accurate ground equipment at Wallops AFB. N. M. Boring will manage the project, with Catalytic performing installation.

Chrysler Vought Corp.'s Structures and Systems Laboratory is engaged in the development of a piezoelectric coating for shock-strain fusion on non-host resistant materials at temperatures exceeding 2000°. Ten-month study contract was awarded to the Aircraft Systems Division, USAF Systems Command.

Booth Aircraft Corp.'s Boulder (Colo.) Division has been awarded an \$800,000 contract to build two types of semiconductors for transporting Titan II fuel and oxidizer. Armstrong Services Division awarded the geostrophic contract.

Avion Corp. received a \$4,418,000 contract from the Navy's Special Group for design and fitting of the Polaris missile.

General Electric's Defense Department has been awarded a \$1.5 million contract to develop Naval Rules Research Station model telescope aiming reference system.

Leas, Inc.'s Instrument Division, Grand Rapids, Mich., recently received an \$8,112,000 contract from Navy's BuAircraft for all-weather refueling and low-altitude bombing system.

Leas, Inc.'s Santa Monica, Calif., will install automatic flight control system including L-5H autopilot and associated instrument system, in New York Airways, Inc.'s new fleet of Boeing 747-100 24-passenger helicopters. System allows pilot to select altitude course, or direct the 307 to hover over a position by pushing a button.

More than 100 General Electric (J75-GE) SA turbojets for the General Dynamics/Tenth World B-58A Hustler bomber are being modified to -50-psi operation by Southwest Aircraft Co., Dallas, Tex., under a contract for approximately \$100,000 from the U.S. Air Force. Contract calls for the first work on the J75-type powerplant by the company.



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HAROSYN features a rotary position transformer in which the primary windings and the secondary windings are made a rigid integral part of the housing and rotor assemblies respectively. No mechanical contact whatever is made between rotor and stator. Dimensions approximately 20 percent shorter and exceeds all applicable portions of MIL-S-30796.

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UNSEEN BUT NEVER LOST. Far down in the secret depths of the sea America's Polaris submarines can cruise for many weeks, poised for free world defense. Without surfacing, men of these submarines can pinpoint their exact position constantly. The equipment to perform this precise duty is called Mark II SINS (Ship's Inertial Navigation System). The first operational SINS was designed, built, and delivered in record time by Autonetics.

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FIRST MK. 2 version of the English Electric Lightning jet fighter lands at Winton Airport, London, after its maiden flight.

Mk. 2 English Electric Lightning Production Under Way

London—Production of Mk. 2 version of the English Electric Lightning jet fighter is now under way at the company's Winton, Leamington, airport, along with the Mk. 4 two-seat trainer.

Mk. 2 Lightning changes are minimal along with the weapons control system, but English Electric claims to claim design changes probably are Rolls-Royce RA 24R turbojets producing 14,500 lb. thrust with after-burning.

Still under development is the Mk. 3 version, which may have a higher powered Avon engine for better climb to altitude such as the Rolls RB 146 Series 500 which produces 15,000 lb. thrust with after-burning. Weapons for the Mk. 3 might possibly be the Red Top, an improvement on the de Havilland Firebreak 4 now under way.

Eleven Mk. 4 trainers, designated the Lightning P 11, have been built and most have been delivered to Royal Air Force. All units include extensive use of titanium.

Since first flight of the Lightning prototype trainer May 6, 1957, there has been only one major production change, an increase in air intake.



LIGHTNING PRODUCTION has at Winton shown placement of upper Rolls-Royce Avon turbojet engine with Avon plate removed. Ridge behind canopy section correct breakers, Avon gas and engine intake tank for starting. Still below wing leading edge is access for de Havilland Firebreak nozzle. Tapered-shaped structure seen in rear of canopy is plate to mount for Perroti de Havilland radio system.



FORWARD FUSelage is shown under construction at left. All section of the Lightning's fuselage is mated to wing section at right.





FUEL CELL test is conducted at left in Aerospace Corp.'s Aerochemical and Propulsion Laboratory's Chemical Propulsion Department. Certain combinations of compounds and catalysts which would generate power by electrochemical reaction are being tested. At right, an engine component is pushed in the laboratory's applied chemistry section to determine its chemical properties.

Aerospace Corp. Has Large Research Role

By Irving Stone



FIVE SUBDIVISIONS of Aerospace Corp.'s Laboratories Division are diagramed.



ORGANIC COMPOUND is tested in an oven at Aerospace Corp.'s Aerochemical and Propulsion Laboratory's Chemical Propulsion Department to determine its chemical properties at various temperatures. That is part of a series of engine component research being made of the chemical properties of engine components that may be suitable for use in remote vehicle cells or transistors.

This is the second article of a two-part series on Aerospace Corp. The first article (AW Aug. 7, p. 12) delineated the organization and responsibilities of the corporation and its four major divisions—Aerospace Research and Planning Division and the Engineering Division. The third major division, the Laboratories Division, is described in this article.

Philosophy of conducting research was part of the original mission for Aerospace Corp. Its laboratory services, which have not yet attained full organization, is oriented toward basic and applied research in components and techniques directed toward achieving breakthroughs for systems which may apply to some extent in the future.

Approximately 90% of the Laboratories Division's effort currently is in response to customer needs and Air Force requests. The remaining 10% is under control of Aerospace's staff, without approved orders.

Five departments within the Laboratories Division cover practically all the technical fields in space and missile systems except space biology, in which Aerospace has no active programs at present for any of the time. Air Force has extensive programs under way in this field and NASA will join a big role in that area of investigation. If the need should arise, Aerospace is prepared to expand into space biology.

Laboratories Division also serves as a collection source for the Air Force for

basic and applied research from industry. In this respect, it acts as a clearing house to sub out the Air Force of the direction research is taking and the relative services and capabilities of various industry groups. Because Aerospace is not profit it has relatively free access to the relevant information. Industry also comes to it voluntarily with research information to provide Air Force information.

Most of the Laboratories Division's work is subcontracted and there is free exchange with all qualified scientific groups in Aerospace's laboratory programs. Information on programs which are classified is available to those having a need to know and doing work in the specific or a related field.

One of the activities in which all divisions in Aerospace contribute, but which gets the most emphasis in the Laboratories Division, is Applied Research Management. In this activity Aerospace assists the Air Force technically in the management of industry and university contracts in applied research. It advises the Air Force on progress of the work and places which look promising. Roughly \$300 million of applied research has originated from Defense Services Division/Space Section. This unit funds contracts in the category number in the handbook.

The broad effort of the Laboratories Division—covering practically the entire spectrum of basic and applied research—is divided among the following:

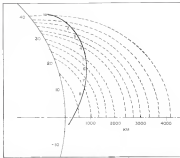
• **Physical Research Laboratory:** This activity had considerable momentum when it began operation, because about half of the members of the technical staff have transferred from Space Technology Laboratory's similar activity.

The basic aim is to conduct long-range research for the development of new physical concepts for Air Force research programs. This involves a broad capability involving theoretical and experimental personnel for such areas embracing physics, chemistry, fluid dynamics, and related areas.

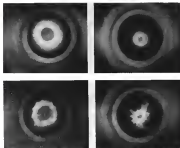
The laboratory is heavily involved in the study of supersonic-droplet matter at a relative to controlled fusion, since this might be the means of energy source or propulsion a decade from now.

Superconducting materials studies also are being performed in plasma propulsion and in actively cooled, possibly by varying the thickness of the shock pattern on one side of cavity body.

Communication techniques through ionized gases are being investigated. Superconductivity may be experienced here during the reaction phase. One experiment being flown on an Atlas vehicle is to measure the conductivity of the hot gases around the entering nose cone. Another area of research suggested by



GRAPH showing relationship of Atlas SCRM flight trajectory in October, 1960, to ionospheric field in another random experiment conducted jointly by Aerospace's Space Physics Laboratory and Lawrence Radiation Laboratory to measure spectrum of trapped particles in outer regions belt. Left curve represents satellite's surface with degree of ionospheric latitude. Heavy curve is Atlas trajectory divided into altitude zones. Dotted lines are magnetic lines of force at various distances from earth. Work is being conducted to allow flux and energy spectrum at each of the altitude intervals shown on the trajectory.



KERR CELL photographs of ionosphere plasma experiments in Physical Research Laboratory show pinched and arc around distances plasma compressed by rapidly rising longitudinal magnetic field produced by 210,000 amp fluxing in 1.8-m-dia. inductors wrap around plasma vessel. Plasma shows successive configurations (top left, top right, bottom left, bottom right) during alternate contraction and expansion of plasma column with control development of instabilities. Interval between configurations is about 0.4 microseconds.



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PARADAY CUP SYSTEM being designed in Aerospace Space Physics Laboratory to measure the flux and spectrum of electrons and ions in energy interval of 1 to 50 keV.

this effort is the technique for raising the conductivity.

The laboratory is following the Air Force General Atomics Project Office to ensure that it is supported properly and that the research is properly assessed.

The program has long-range potential, through controlled atomic explosions.

Theoretical studies are being pushed to find mechanisms, plasma flows and superconductivity. This last category involves potential in the creation of strong magnetic fields for plasma propulsion, and may be useful in connection with fusion research.

Approximately 25 members of the technical staff are employed in the Physical Research Laboratory.

Space Physics Laboratory. This activity is divided into three departments: Space Physics, Upper Atmosphere and Quantum Physics. One of the space physics efforts has been implemented and includes the study of solar particles, radiation belts, magnetic and electric fields in space and lower atmosphere. Emphasis will be placed on lunar plasmas and studies later in the program. The laboratory is cooperating with UCLA's Lawrence Radiation Laboratory for the use of neutron bombardment to make a rough analysis of lunar surface composition. Systems will make surface material composition measurements—the specific area being studied depending on the specific material. New instruments will be supplied by a small contractor. The experiment is being proposed to NASA, and may be carried out on one of the Saturn or V-landings.

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The Radio Corporation of America is prime systems contri-

butor for BMEWS. At the CDC, RCA's Display Information Processor computing apparatus automatically evaluates missile sightings, launch rates and target areas. By means of data processing and precision equipment provided by RCA and a team of other electronics manufacturers, the findings are displayed on huge, involving high map-viewers in coded color symbols, providing the NORAD battle staff with an electronic panorama of the North American and Eastern land masses.

The handling of BMEWS inputs at NORAD is an example of how RCA data processing capabilities are assuring the high degree of reliability so vital in commercial defense.



At NORAD headquarters, RCA tracking equipment, the Display Information Processor, instantly converts data from radar stations, displays data from display and processes it for computer output.



RCA is prime systems supplier for the operating BMEWS radar site radar network which existing electronic systems will detect, identify and provide early warning of missile attacks.



RCA's Automatic Checkout & Monitoring and Alert capabilities test and check performance of portions of the system and alert an operator when a needed repair is needed on the system.

One of the defense needs of today is a new generation of RCA electronic data processing capabilities in research, design, development and production of data processing equipment for space and defense projects. For information on these and other new RCA scientific developments, write Dept. A16, Defense Electronics Projects, Radio Corporation of America, Camden, NJ 2.



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linear vehicles for which Hughes Aircraft Co. is prime contractor.

For investigation of solar particles, the instrument will have a solid proton spectrometer on the Area A Magnet 314 for cosmic-ray satellites. The purpose of the experiment is to determine the energy spectrum of protons which might be emitted in space-weather and flare conditions. Measurements will be made over a substantial period, probably six weeks. The detector portion of the spectrometer will be built at Auto-Quon.

Experiment for radiation belt measurements is being prepared for a polar-orbiting satellite, such as Midex. As a payload unit, the experiment will pass through the normal zone for electronic measurements.

Quantum physics activity will study surface properties of the atmosphere—absorption and transmission for various wave lengths with respect to infrared and ultraviolet radiation. Results of the research could have substantial application to both sub-orbital and space vehicles.

Upper atmosphere research will involve structure of the region and will be implemented in the laboratory with experiments with spectrographic equipment on ultraviolet to a vacuum, such as concentrations of gaseous molecules. A similar experiment also is projected for space flight.

Materials Science Laboratory. Finally, work schedules and staff for this activity still are being built up. In the field of solid-state physics, the laboratory will concentrate on the effects of very strong magnetic fields on metals as a basic research effort to determine fundamental electronic structure of these materials.

Research will be a long-range effort to demonstrate a solid theory of constant alloying.

Extreme group of metals to be investigated probably will include titanium and zirconium. Others such as iron, nickel and chromium, which have been magnetic properties, are likely to have value in electronic applications. Also aluminum and molybdenum are refractory metals which are expected to find use in high temperature, high-strength applications.

Typical work will support Air Force projects under nan. Properties of air-based detectors will be studied for support of various defense programs. The effects of ultraviolet radiation on solar cells also will be investigated.

Work in support of research in other laboratories will include investigation of the possibility of using superconducting magnets to obtain very high field strengths, with possible application to plasma propulsion. In the field of applied science in metallurgy and ceramics, high tempera-



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The Primary Standards Laboratory at Hercules' Bascohus plant has a fundamental accuracy of four one-millionths of an inch.

This is second order only to the National Bureau of Standards in Washington. Here is the calibration point for all measuring, gaging, machining, and assembly of the third stage motor for Minutemen, the advanced second stage motor for Polaris, and in development of the ultragigaton retrorocket for Ranger.

There is good reason for such stringent physical accuracy. Missiles or space vehicles—whether they are to travel hundreds or thousands of miles, or into far distances—must travel with pin-point precision. And, unless the final stage is manned, or under cybernetic control, the precisions of its final course are purely ballistic: the force, mass, and direction with which its motor was originally enclosed.

The forces of force and time are subject to chemical prediction; precision and dependability in this area are the backbone of Hercules' current contributions to missilery. Direction of application, however, is a purely physical thing, and calls for new orders of accuracy in manufacture. It is for this reason that the Primary Standards Laboratory at Bascohus is one of the key arms of the Chemical Propulsion Division.

Chemical Propulsion Division

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The new and improved version of the Whirlymite Self-Trainer has completely computerized its flight training.

Ground instrumentation on package (below) now incorporating digital data from the Whirlymite Self-Trainer, enhances flight training.

ture materials will be investigated to extend knowledge far beyond the degree of vibration reported now. Effect of fabrication techniques on material characteristics also will be investigated.

For example, work already has been performed with berillium oxide to determine the effect as a function of temperature, time and pressure applied to the powder to produce plate material about $\frac{1}{8}$ in. thick. With this data, a theory has been formulated on the critical shear stress and permitted prediction of the type of dense body which would be obtained under different processing conditions.

One possible use of berillium oxide is in chemical radiation because of the material's high thermal conductivity and high electrical resistivity. Another characteristic of the material is its relative transparency to neutrons, suggesting application for high temperature neutron or X-ray windows. The material is not completely transparent, hence will absorb some neutrons and heat up, and because it is more resistant than aluminum oxide to thermal shock it may be suitable for very high power electron applications. An outstanding characteristic of the material is that it is corrosion proof.

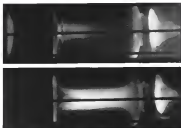
Other materials being studied for relation of heat physical and chemical properties to fabrication techniques include very high melting-point compounds such as the carbides, nitrides and borides.

The laboratory now has about 38 members of the technical staff and about 200 laboratory technicians. By the end of Feb. 1965, more level is expected to be about 60 technical staff members, the full staff for the laboratory on the basis of present projections.

• **Acoustics and Population Laboratories.** This activity provides technical support for major programs of Aerospace and also conducts its own research programs. The laboratory is Aerospace Research Department provides technical cooperation in the areas of acoustics, specifically ballistic wind tunnels, lifting devices and projectiles with specific signatures and drop studies.

In Acoustics Department is performing acoustic studies with major areas of interest in high-temperature gas dynamics work in interaction of electromagnetic waves with sound gases and cross-sections of particles which have been demonstrated in sound. In support of this work, an experimental shock tube facility is used for studying resonance. Significance of the work is that it affects specific acoustic phenomena transmission and reception and source signatures.

The Advanced Population Department is in the process of being estab-



PHYSICAL RESEARCH LABORATORY work photographs (above) show that theory of laminar plasma column varied through a 400-micron laser beam. Time is from left to right. In upper photo, pre-ionized RF current produces initial convection and current ends before beginning of main discharge. In lower photo, current and main discharge begin simultaneously and there is no initial convection (visible in top photo). Presence of confined laminar column induces some stabilization in operation. Hydrogen plasma (below) generated by discharging capacitor bank in hydrogen at initial pressure of 100 microns under Mach 100, rapidly during shock wave through cold gas which dissociates and ionizes, resulting in electrical conductivity of 10¹⁰ ohm-cm. Lower photo shows initial shock cell in magnetic field, upper shows same condition with moving magnetic field.



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lated for rendering both base and applied research. It will cover electrical propulsion—use of plasma propellers and techniques for accelerating ionized gases—thermionic conversion, magnetohydrodynamic conversion, and trends of thermoelectric conversion.

Laboratory work is being performed on a thermionic converter, pulse plasmas and arc plasma propulsion devices and magnetohydrodynamic energy production.

The chemical propulsion department is conducting performance of advanced liquid and solid propellants which produce rotational torque on thrust. Liquid hydrogen-fluorine propellant is being evaluated in relation to the entire range of factors which affect system performance. With solid propellants, the department is concerned with the effects of various type additives to improve impulse capability.

Regenerative fuel cells for energy conversion are being studied. The burden of applied research and phenomena related to electrode reactions in fuel cells overall efficiency of the system are being studied.

Feasibilities of organic semiconductor also are being studied. Theory is that if organic materials can be found which will conduct in solid-state devices, an entire field of inexpensive, single transistor type peripherals will be opened, with semiconductor possibilities.

Emphasis currently is on polydiacetylene and polycyclic compounds which are likely to share unique electrical properties, different from those of metal or conventional semiconductors. Work proceeds a experimental engineering reference organic and physical laboratory facilities which Aerospace has.

Heat Transfer

Heat transfer and fluid mechanics activity is an expanding research nuclear configurations, and fluid vector control devices for solid propellants. Ablation phenomena are being studied both for propellant and reentry applications. Aspects of solid propellant also are being considered, such as phenomena associated with vortex source concepts of the gaseous nuclear reactor. This work is done in conjunction with Los Alamos Scientific Laboratory.

Approximately 15 members of Aerospace's technical staff are employed in the Aerodynamics and Propulsion Laboratory. Based on present projections, the number should increase to approximately 100 within a year.

• **Electronics Laboratory.** One of the very important areas problems under study in this facility is that of deep space communications and radio-band telemetry, which now are operating

near the limits imposed in radio-as space direction, transmitting tube in tubes, and available schedule power.

Specialists in electromagnetic and communications techniques are studying sophisticated systems in which the antenna becomes an integrated part of the total communications system. For example, the use of extraneous signal return areas (Vias) into actual mode active in printed solid-state amplifiers appears to be exceedingly attractive for spacecraft communications.

Another area considered of great importance is quantum electronics, particularly the study of the behavior and application of the laser (optical mirror) which permits coherent generation of optical and infrared radiation making it possible to obtain light beams of very high directivity. Coherent techniques is important to the development of coherent microwave generation in the late 1970s. The laser should permit order of magnitude improvements in ability to communicate, track, and perhaps destroy objects in space.

Solid state electronics activity is conducting a comprehensive study of superconductivity in thin films. Feeling is that greater understanding of superconducting phenomena can pay large dividends in space programs—whether the gain from superconductor thermoelectric techniques to the use of ultra-high magnetic fields in propulsion systems. Head of the Laboratories Division is Aerospace Vice President C. W. Shivers.



Beating Antenna

Beijing Co. will enter long-term business with glass fiber reflectors which companies can hold that surface tolerance of 0.005 in. Slashed shock proposed antenna with 10 ft dia. shock. Beijing concepts is proposing to several government agencies.



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AVIONICS



UNFURLABLE SOLAR COLLECTOR, capable of following sun's rays and furling down into an shelter at its base, consists of 15 electroformed metal petals which can be unfurled from folded condition into petal-like collector. 32 in. in diameter (right). Feasibility model was made by Electro-Optical Systems, Inc., Pasadena, Calif. for USAF's Avionics Systems Division.

Unfurlable Solar Collector Is Developed

By Barry Miller

Pasadena, Calif.—Working model of a lightweight, passive collector capable of collecting like a flower in space from efficiently collecting and concentrating enough solar heat for a thermoelectric or a solar chromatic power system will be delivered to the Air Force shortly by Electro-Optical Systems, Inc.

Large area solar collection for use of several support components that will be needed for those space power systems which will use the sun's heat as an energy source in converting solar to electrical energy. A number of different types including collectors which are inflatable, manually storable or expandable are being developed.

The model built here and being delivered to the Air Force's Avionics Laboratory of the Avionics Systems Division is intended to demonstrate the feasibility of a lightweight, portable, inflatable and foldable of interlocking mechanical assembly. It is 12 in. in diameter when expanded, considerably smaller than a practical, unfurlable space collector would be.

Other companies are studying similar petal-like collectors. The Tapco group of Thompson Ramo Wooldridge Inc. is designing and developing a 32-in. diameter flexible petal collector, which can be opened in space, as part of its participation in National Aeronautics and Space Administration's Spacecraft I-340, solar auxiliary power project.

Electro-Optical recently was asked by the Avionics Laboratory Laboratory to make petals for a 42-in. diameter collector under a separate contract.

Electro-Optical's model collector consists of 15 reflecting petals circularly arranged and hinged to an actuating assembly at the center of the sun. The collector sun including the assembly at support, weighs about 2.5 lb. It can be expanded from its folded configuration in approximately 20 sec., according to Charles W. Stephens, is associate manager of Electro-Optical's Advanced Power Systems Dept.

Actuating mechanism employed in the Pasadena model is a hydraulic action although this might not be the appropriate technique for space operation. Some emphasis of the development was on the concept, the collector



SECTIONAL VIEW of solar collector shows arrangement of components. Collector was developed by Electro-Optical Systems. Larger model of the device could be stored in space vehicle then unfurled in space.

and the quality of the petals, not the actuator, a current action for keeping the collector properly oriented with respect to the sun was requested by the Air Force. The company found one of its own collectors having been used in the past.

In the process of furling, alternate petals are radially displaced about a turn of an inch to provide proper clearance in the furling operation. These displaced petals fold in sequentially about 30 deg., then the remaining petals follow.

Electroforming Process

Collector petals are fabricated by an electroforming process which is more akin to electroplating. They are made entirely of metal (except for hinging part), constructed with aluminum for achieving better reflectivity. The surface-reflecting area of each petal is about 0.52 sq. ft. giving a total of 7.8 sq. ft. surface area of collector. Specific weight of each petal is 0.24 lb., while weight of the metal is 0.045 lb. per sq. ft. of thickness.

In fabricating the petals, the sun or vehicle of the center is formed in a vacuum chamber where vacuum surface will be spread over the sun. A backing material is attached, the backing structure of the petal formed and the center then removed. An electroformed holder is attached and finally the petal is removed from the vacuum chamber and activated with aluminum.

The petal collector can achieve a concentration rate of at least 2,000



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cuts wing spar forged weight by 895 lb



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Beam Modulator

Light beam modulator, which operates at microwave frequencies, has been developed by Sperry Gyroscope Co., Great Neck, N. Y. Company says device should find use in space vehicles for navigation purposes and in vehicle-to-vehicle communications.

compared with a better figure of about 17,000 for a solid collector. The difference is accounted for by a larger focal area needed by the petal collector because of poorer reflectivity. Conversion ratio is the total collector area divided by the area of the focal area.

The sun's rays are focused onto an absorber at the focus of the parabolic collector. Depending on the coating placed on the petal, they have been able to individually reflect as much as 90% of the incident energy spectrum. About 90% of the total collected energy from the petal collector can be trapped in the 1-in. dia. feed area.

Efficiency of the mirror for operation with a Rankine cycle engine at 1,100°F would be roughly 36%. Efficiency is defined as the ratio of power delivered to the engine to the power striking the mirror. A solid mirror of this size has an efficiency of about 85% efficient, Hughes says.

At higher temperatures, such as those which would be required by a practical thermoelectric converter, efficiency of both the solid and the petal collector would drop, the latter to a greater extent. A solid collector would taper to 77%, according to Thermophysical calculations, while the petal collector would fall to 50%. Hence, present applications for the petal collector concept would be with solar dynamic and other nonradioisotope power sources.

Nonradioisotope design would degrade the reflectivity of the mirror by about 1% a year if the mirror were employed as a satellite in a 360-day earth orbit, Hughes indicates.

Advanced Division of Garrett Corp. has developed petal collectors as one part of its work with solar dy-

namic space power systems. Its present interest is primarily with development of metal collectors.

Another device for collecting the sun's heat is being produced by Goodson Aircraft Corp. under a subcontract awarded recently by Sandstrand Corp. This will be a 4-ft. dia. shaped reflectable reflector made up of 15-in. Rankine cycle turbine engine nozzles (AW Aug. 22, 1960 p. 69) that Sandstrand's Tulsa Division is making for USAF's Aeronautical Systems Division.



► **Apollo Requires Special Radio-Spectroscopy**—Telemetry and spacecraft radios will be sought by National Aeronautics and Space Administration in its acquisitions for a new equipment to be used on the Apollo-marked lunar spacecraft. The spectroscopy radio will have to be capable of measuring the distance from the vehicle to the earth and the moon during flight. All systems gear for Apollo including communications, navigation, guidance and control, plus additional systems will be obtained through present agreements from current competition for the spacecraft and its payload (AW Aug. 7, p. 28).

► **Ballistic Missile Descriptions**—Requirements of ballistic missiles operating in the earth's atmosphere will be studied by Electro Optical Systems Inc., under a \$140,700 contract from Advanced Research Projects Agency.

► **Alcon Composite Actions**—Working lease Electric has formed General Electric Molecular Electronics Dept. at Youngwood, Pa., to develop, produce and market microwave functional blocks. Fred M. Hollings is general manager. Other recent moves in the research level include:

► **Raytheon Co.** and **Indian Instrumentation** has formed first American major business enterprise known as Science-Action Private, Ltd., at Foster, Ind. Raytheon, in which Raytheon owns one-third interest, is expected to be producing instrumentation and data for the civil of current radar, the company says.

► **Science Foundation Corp.**, New York, has acquired 90% ownership of **Spacelab, Inc.**, San Diego, aerospace manufacturer. New acquisition has developed radio altimeter for low-altitude use which is expected to be accurate to within a few inches, the company says.

► **Sperry Corp.**, Inc., Huntsville, Ala., is now company, formed by former employees of NASA Marshall Space Flight Center, to produce spectroscopy and molecular electronic equipment. Company president is William B. Conner.



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BY 895 LB

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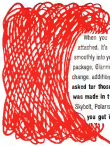
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• **Micro-miniature capacitors**, using laminated dielectric available in a standard 1/2 in. square (1/16 in. thick) one is listed as company's least of micro-miniature capacitors ranging in value from 0.01 to 0.075 microfarads. Recent addition to line, a 0.075 microfarad, 250 v d.c., with capacity variation of less than 10% from -15 to +50°C. All values are available in 10 and 20% tolerance for fast delivery at prices which range from 30 cents to \$2.00 each in quantity. Manufacturer American Components Corp., 13722 Glenview St., Lenexa, Calif.

• **Micro-miniature Chord oscillators**, Type W651, measuring 1 in. in diameter and 3 in. in length, is available as developmental model. For pulse pulse use, oscillator can provide peak pulse power of 50 to 100 watts in the 1 to 5 kHz range (average range is one 100 ms. segment of the 2 kHz range). A CW version can have an 800 ms. segment of the 5 to 15 kHz range. Power not put in approximately 5 watts. Manufacturer Trak Microwave Corp., Tampa, Fla.



• **Absolute pressure transducer**, Model 755, has zero error band specification in accuracy including effects of linearity, hysteresis, nonlinearity, resolution and repeatability of $\pm 0.25\%$. This 4-in. pressure transducer, which the company says will meet all appli-

cable government specifications, has range of zero-6,000 to zero-10,000 psi, resolution of 1,000 to 10,000 ohms $\pm 1\%$ resolution as low as 0.75 ohms, of 16 to 35 ± 23 to 2,000 ohms and constant 3 in. in diameter by 4-45 in. in length. Manufacturer Bureau Inc., 6155 Magnolia Ave., Riverside, Calif.

• **Digital voltmeter**, Model 645, a four-digit, completely transistorized electronic voltmeter. Including basic ranges 99 voltmeters. Voltmeter's accuracy is ± 1 digit, auto reference capacitor is 1,000 megohms. Manufacturer Electro Instruments, Inc., 8641 Teillon Ave., San Diego 11, Calif.

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MISSILE ENGINEERING

SLAM Avionics Must Resist Radiation

De Krom 1. Halber

Dallas, Tex.—Research by Clavin Vaughn engineers on the effects of a high-level radiation environment on electronic circuits and components is quoted for the company's upcoming low-altitude remote (SLAM) program has been successful to the point where the engineers say that they can work specifications with reasonable confidence that the environment will enable

Experience to date highlights the value accuracy for selection of milestones in the engineering and estimate tasks, according to the firm. Confidence level is such among engineers working on the project that they can they could begin planning toward a specific flight date with 90% confidence that they would meet the target.

A major breakthrough in finding a

expected this fall, with opening of a \$15,500 Nissan Xterra 1 competition for the superiorly machine-assembled for altitude music.

Advanced Subconnections

Approximately a dozen firms are contributing to Chance Vought's electronics research program, including hardening the system to withstand effects of nuclear radiation. This teamwork, encouraged by Vought, has provided the kind of progress that leads its engineers to confidently forecast that no new inventions are required anywhere in the nation to make SEANT a light-stroke vehicle. This couldn't be said a year ago, they add.

installing TERCOM's guidelines system, for which it is the principal contractor. TERCOM Phase II has proven itself in the metal light evaluation phase—above a two-engine An F-46 fitted with—and now awaits study of how effective it will be under a situation in which, utilizing relative aircraft components and capacity plus a new customer, which is not on contract.

It is also clear that the basic SLAM concept based on a nuclear triangle population matrix provides several important benefits to the engineer in system design. Since the validity of assumptions need not be concerned with the design of the problem, the human factor is the high performance of this powerful analysis might problems associated in equipment design, making correct and component redundancy possible to improve the solution level. Tests have shown that close more components having a capability of maintaining more than a million operations per second can be taken into the human can be designed with reliability.



Navy to Launch Q-4B as Target for Talos Missile

Q-1B missile target drones built by McDonnell Douglas of Northrop City, for USAF will be launched from Holloman AFB as targets for Navy Talos surface-to-air missiles. The Q-1Bs—prototype and test models left over from the second- and third-phase USAF program—are being procured by Navy. The Q-1B (AIA Sept. 28, 1958, p. 79) is powered by a General Electric TP538-G1 turbojet engine with afterburner. The aircraft, outfitted with a parachute recovery system, is designed to simulate a Mach 2 bomber.



Vickers Vigilant Anti-Tank Missile Fired

Winged Vickers Vigilant anti-tank missile is fired from a launching rail launcher. Note launch control system on trailing edge of each of four fins. Missiles were fired at the missile 440 yds. (APR 30, 1966, p. 14, July 24, p. 40).



Cubic all-weather tracking system gives detailed analysis of ADC scoring missions

When a rocket or missile streaks from the armament bay of an interceptor over the Eglin Gulf Test Range and harkles toward a target drone, a unique Cubic tracking system goes to work. Called MATTS for Multiple Airborne Target Tracking System, it gives the Air Defense Command a complete running account of every phase of a scoring mission and prints out a full record of the intercept problem for later analysis.

MATTS has already demonstrated an unusually high level of reliability in continuous ADC operation. It has been scheduled as primary scoring instrumentation for ADC's next biennial weapons meet (Operation William Tell '67) to be held on the Eglin Range in October.

MATTS operates day or night, in any kind of weather, continuously measuring and plotting the trajectories of the interceptor, the missile and the target drone. The system

tells everything about the mission, including the distance and direction of the missile from the target, and from the interceptor, at the time of successful burst.

Cubic precision electronic tracking systems, of which MATTS is just one example, are in world-wide use for scoring, cargo safety, air traffic control, satellite geodesy and radio/telemetry acquisitions. For information, write Dept. AW-168, Cubic Corporation, San Diego 11, Calif.



EMPLOYMENT OPPORTUNITIES... Many challenging space age projects at Cubic invite inquiry from experienced engineers and scientists.

December 11. Worth's ground test results state:

Basically, the considerable results done here have indicated that systems that use high/temperature-resistant and inherently vibration-resistant and that solid state type electronic components are sensitive to radiation effects.

As explained by Project Engineer John Mitchell, the radiation effects of the Pulse magnet population system, which is proposed for SLAM for example are in the range above electronic equipment tolerances—flashlight over 10¹⁰ fast neutrons/cm² to 10¹² fast neutrons/cm², overexposure, "hardening."

Radiation hardening techniques, which involve developing the nuclear damage threshold of each component by using the Radiation Effects Mechanism Analysis System (REMANS), have made it possible to raise the threshold to 10¹⁰ fast neutrons/cm² and higher. In the case of ceramic tube devices, for instance this level has been raised to 10¹² fast neutrons/cm² and successfully tested in operation under a steady-state nuclear environment for 100 hr.

Targets Noted

On the basis of these studies and with the background of considerable other research in effect agencies, including those engaged in the Aircraft Nuclear Project, several general trends in characteristics of electronic components as a result of radiation effects by radiation were described by Mitchell, including:

- **Minimize and insulate tubes** to minimize a general reduction of electron current emission in control and current and a change in conductivity. Some tubes experience fissures in the glass can develop or bending of the glass to metal seals. Light-sensitive devices undergo an erratic increase in dark current due to gamma radiation and a change in sensitivity has been noticed because of discoloration of the glass.
- **Resistors are dependent** on material composition and manufacturing process. Initial resistance values of carbon composition resistors may change 10% with higher resistance values showing greater degradation. Wirewound resistors are the most stable standard type resistors for operation in steady-state radiation fields.
- **Capacitors usually exhibit a change in capacitance**, an increase in the dielectric loss factor and a decrease in leakage resistance.
- **Transistors may be affected** by ionization and deterioration resulting from the change in structure of the p-n junction and there also will be a reduction in saturation resistance between windings in some cases, the magnetic properties of the transformer core is altered.

Recognition of these general trends permits hardening of most off-the-shelf

equipment in following some basic steps: Mitchell summarized them as follows:

- **Select a reliable piece of equipment** that will perform the required work function.
- **Decrease the environment-radiation** in addition to non-radiation—so which the equipment must operate.
- **Evaluate each component** of the equipment to determine if it will meet the environmental requirements.
- **Eliminate the weak links** and replace with more radiation tolerant components.
- **Redesign**, where direct component substitution is not possible, to compensate for the radiation effects, or redesign to utilize a different, more radiation tolerant component.
- **Keep the model design as simple as possible.**
- **Be careful in recent components** to avoid placing high impedance loads adjacent to one another and keep current level "clean."

Component Tests

Tests on actual components and circuitry that were assembled in bread board form, and then operated through middle throughout during a 100 hr. radiation exposure period, with complete set of current operating data being taken every two hours showed these results:

A miniatured wire drone amplifier failed completely within a half hour after the radiation test started. The test integrated full neutron flux was approximately 5 x 10¹⁰ fast neutrons/cm² but this failure was expected as the circuit had been included only as a reference for comparison of actual design.

One diodeless circuit, utilizing an SN 17403 ceramic electron tube failed after 45 min. of radiation, but this is be-

lieved to have been a random failure rather than a result of the test, since an identical circuit remained operational for the complete 100 hr. of testing.

A synchronous amplifier failed in operation approximately after 45 hr. and completely recovered at 75 hr. and even resumed to operate properly for the remainder of the test. The cause was determined to be a temporary change in the operating characteristic.

A vector driver amplifier failed after about five hours of radiation and another motor driver amplifier became inoperative after about 60 hr., failing completely at 90 hr.

Twenty of the 34 circuits tested were still functioning properly at the end of the 100 hr. of radiation.



Miniaturized Gyro

Miniatured Gyro with two degrees of freedom (right), developed by American Bosch Arm Corp., single only one-fourth as much and occupies only one-fifth the volume of similar gyro which Arma builds for Atlas as well as guidance systems built. New gyro uses an inner gimbal which is a sealed fused borosilicate glass containing spinning rotor. Another sealed outer borosilicate ring provides second degree of freedom. Arma says it expects to apply new Gyro to advanced BOMBS guidance and space vehicle navigation, as well as to use of the company's alignment (north seeking gyro) program. One was developed under Air Force sponsorship.

deterrence

In Navy's Polaris missile system—a major contribution to free world defense—it's a matter of "as the submarine goes, so goes the missile."

Navigation systems manager for this deterrent weapon, Sperry has evolved a system which provides the navigational accuracies required over the weeks and months a submarine is submerged. An inertial guidance system, double checked by a complex of instruments and master computer, not only guides the submarine and pinpoints its position, but telegraphs directly into the missile the exacting data needed to start it on its way. Thus has navigation been called the key to undersea firings: one degree error in the sub's heading means a 20-mile miss for the missile. General offices: Great Neck, N. Y.



Other Sperry contributions to defense missions, precision navigation, tracking and guidance systems for Navy's Terrier and Talos missiles, beam-ride systems for USAF's B-58, Army's Sergeant missile system, Sperry's Polaris submarine navigation simulator frame illustration.

SPERRY



CAMERA TOWERS (left) hold underwater cameras to record launch from underwater. Prime test stand. Note liftable watch over tower base.

Underwater Launch Stand Installed

Variable depth launch facility completed for the Naval Ordnance Test Station, Pasadena, Ariz., on 170 ft. of water off San Clemente Island, Calif. will be used to develop advanced Polaris missiles which can be launched from a wide range of depths.

Security of missile launching sub increases from enemy action will be greater if the missile can be fired from greater depths. The launch facility off San Clemente Island permit pop-up tests or live launches of Polaris missiles from approximately a 75-ft. range of depths.

The launch tower of the facility is hinged and is made of four generally unconnected steel spools in a stack mounted atop an elevated structure.

A hand down watch on the floor of the ocean controls the depth of the launcher. The structure is enclosed to controlled steel pilings act as the ocean bottom. The 500,000 lb. facility has a total weight of 125,000 lb. and is able to withstand a 100,000 lb. wave force load during the launch of one of the developmental Polaris missiles. Two telescoping camera towers are located about 15 ft. from the launcher and 12 high-speed underwater cameras will collect data on the underwater trajectories of the test missiles. These television cameras are planned to let observers watch underwater operations from the staging vessel and the camera observation buoy that houses controls for the test frame.



LAUNCH TOWER BASE, shown during construction, is right-angled steel structure.

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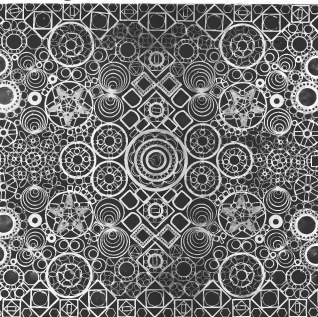
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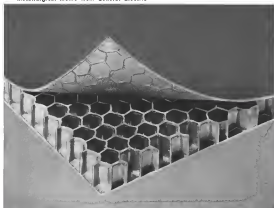
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FINANCIAL

Avionics Industry Growth Potential Seen

By Harry M. Rosen

New York—Avionics industry, as a whole, is still in growth stage, and while some segments of it, such as radar and television have run out of steam, others, such as data systems and space equipment, have phenomenal growth potential, according to Dr. Arnold G. Beckman, president of Beckman Instruments, Fullerton, Calif.

His company is not held in check by the national economy, as some aviation firms. Beckman told the New York Society of Security Analysts, because it merely produces end products for the scientific and industrial research and development fields. Thus, Beckman's market is less likely to be affected by the ups and downs of the economy than is an aviation company selling equipment used in manufacturing or tied to the consumer market.

Beckman manufactures complete data systems and instruments for analysis, measurement, computing, recording and control, and makes only a few components—mainly only those which it can't produce elsewhere.

Beckman was in the semiconductor business through a subsidiary, Shockley Transistor Corp., until Apr. 1, 1960 when it sold Shockley, which had been operating at a loss since its inception, to Civic Corp.

Discontinuation of Shockley has turned out to be a double blessing for Beckman first because the company has been able to apply its resources more profitably toward other divisions, and second because it was put off with its voluntary drop out of the semiconductor business, in which shortouts are being predicted (AW June 12, p. 77).

Company's Aims

Beckman and company are not in company's elective, "speculations" not withdrawing, but that growth in per share company in the end Beckman aims at achieving this by acquisition of companies making products with growth potential that are a logical extension of Beckman's product line, such as Gifford Electronics of Schiller Park, Ill. This company, which Beckman is acquiring in a stock transaction, makes a direct driving centrifuge and other products which will complement Beckman's space instrumentation, industrial and medical product lines.

Beckman said that return on investment is the criterion by which new

product introduction is judged, and that a 30-51% rate of return is regarded as satisfactory for its products.

Often means by which the company is striving for growth, Beckman said, are by trying to keep out in front of its competitors, by keeping close watch on market requirements and by maintaining an effective research and development staff. On this last point Beckman said that 75% of all the company's offers to technical graduates last year were accepted.

Beckman's per share earnings, for the fiscal year ended June 30 are estimated at \$2.50, based on Fiscal 1961 sales of \$61.5 million and net income of \$1.5 million. These are record sales and earnings.

Approximate Fiscal 1961 figures for both Beckman and Gifford are: sales—\$68.75 million, net earnings—\$4 million, per share earnings—\$2.78, based on 1,450,000 Beckman/Other shares of stock.

Beckman's Fiscal 1960 financial results were: sales—\$54,257,282, net earnings—\$3,891,915, per share earnings—\$2.28.

Thus Beckman ended Fiscal 1961 with sales up 20% and profits up 22%.

per share. Government contracts accounted for slightly more than 30% of total business, including \$15 million for research and development contracts.

The company is "very active" in satellite communications, Beckman said, and looks for sizable research contracts for space project instrumentation. Beckman said this type of research contract is particularly desirable because it, as a rule, is not project work which can be produced for industry. Beckman is developing a laser radar analyzer for Jet Propulsion Laboratory's manned, unmanned Project Saturn vehicles (AW July 3, p. 62), and developed and built some major components of the Project Marsen space telemetry instrumentation (AW May 12, p. 47).

The company's current growth rate is 30-35% a year and this rate is expected to apply to 1962 financial figures. The firm ended Fiscal 1961 with a record backlog but the dollar amount of this backlog is kept confidential for company's reasons.

William W. Wright, Beckman Instruments financial vice president and controller, told the security analysts that Beckman had a cash balance on June 30 of \$7 million. With the working



Toxic Propellant Burner

Pyran burner system, built by Avco, Inc., will be used at Titan II facilities at Denver and Cape Canaveral to dispose of toxic propellants such as hydrazine and nitrogen tetroxide.



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AERONCA designs and produces precision antenna systems for advanced radar complexes

Pursuing new concepts in design and construction, Aeronca parabolic antennas set new standards in precision... expression of style. The principles and accuracy inherent in the advanced X-Band dish illustrated above are adaptable to antenna designs of virtually any size or shape.

Aeronca antennas are lightweight high-strength rigid structures of honeycomb sandwich construction. Developed by integrated design-tool-produce capabilities, they are fabricated by advanced techniques that substantially reduce tooling requirements... simplify unit design... assure low-cost producibility. In addition, Aeronca antennas permit lighter support structures and mechanisms because they weigh 40% to 60% less than conventional designs.

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dished complete design of antenna
for efficient low lossing ratio.



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for service maintenance of
5000.

capital reported as an annual basis ranging about \$1 million, Wright said that the \$5-million remainder should serve the company's capitalization needs for about five years, based on a conservative growth rate.

The company received new capital of \$7.6 million through an offering of 40,075 shares of common stock for subscription by stockholders on the basis of one new share for each 20 shares held (AW Mar 25, p. 99). This offering was made for the purpose of paying off short-term bank loans and to help defray the cost of plant expansion and new equipment.

In Total 1961 Beckman completed building progress totaling a total of \$2.5 million, including additions to engineering and manufacturing facilities at Fullerton and Palo Alto, Calif., and construction of a 200,000-sq-ft building at Fullerton for the Systems Division, which produces data processing equipment.

Capital expenditures in Fiscal 1961 were \$3.9 million and depreciation was \$0.7 million. Capital expenditures in Fiscal 1962 are expected to be \$2.4 million and depreciation is expected to amount at the \$1.7 million level.

Beckman common stock is listed on the New York Stock Exchange. The price recently moved up to the 110s with a high for the year of 1951 and a low of 57.

Mergers and Acquisitions

An Products, Inc., Allentown, Pa., has acquired complete control of its British subsidiary, An Products Ltd., from the Birtcher Co., London, England. The transaction, involving \$2,495,000 cash, will be completed by September. An Products had purchased a 51% controlling interest in the company in 1957. The British company which designs, builds and assembles major guns and other ordnance equipment, has annual sales exceeding \$5 million.

Lamed Corp., Hillsdale, N. J., will acquire the government products division of psychiatric manufacturer M. Szentfal & Co., New York City and Raritan, N. C. Martin and Augustin Szentfal will head Lamed's Szentfal Division following acquisition based on an exchange of stock. The company produces personnel and cargo shelters, air-sealable drug chamber trailers and space capsule recovery parachutes, with sales of over \$6 million last year.

Farfield Stokes Corp. has acquired Tri-North Laboratories, Versailles, Ohio, which specializes in gas-turbine bearings. The business and equipment



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ness, the legal and linguistic nature of products, machinery and commercial practices, maritime matters and other electronic instruments. Offering is 500,000 shares of common stock, for public sale on an all or none basis, public offering, prior and underwriting terms to be supplied by a memorandum. Proceeds, together with other funds, will be used to finance, will be applied to the start of expanding its business through the development of new and improved products and to the attainment of its long-term goals. The company intends to apply \$157,700 to the refinancing of a 1976 Isuzu truck and \$494,000 to further development of the last of several products. Let's be the company, the remainder will be used for general corporate purposes.

Radiation Instrument Development Laboratory, Inc., Northridge, Ill. began under Illinois law in 1957 and is organized under Delaware law in Maryland. The company is engaged in the development, design and production of electronic instruments and systems for the detection, measurement and analysis of nuclear or atomic radiation. The company has a total capital stock of \$6,666,666 divided into 666,666 shares by the company, and 13,334 outstanding shares. The present holders of the shares are offering stock and bonds for the purpose of raising \$1,000,000 for the purpose of financing the development and construction of a new plant. The company's stock will be added to general funds for working capital purposes in the amount of \$1,000,000. The company's stock will be added to general funds for working capital purposes in the amount of \$1,000,000. The company's stock will be added to general funds for working capital purposes in the amount of \$1,000,000.

ETH-Helios & Cabot, Inc., San Francisco, Calif., engaged in installing electrical and electronic systems in tank production facilities and in mobile air conditioning units. The company also provided support services for testing and operational trials as well as construction team systems and tracking systems. The company's 1995 sales of equipment, 100,000 shares for public sale by the company, and 100,000 outstanding shares by the parent holder placed The offering of the company's common stock in the public offering market and converting term to be applied by management. Proceeds from the company's sale will be added to funds of the company to be used for the company's operations and to be applied for working capital. The company anticipates that substantially all of the proceeds will be applied mainly to the reduction of short-term debt and to the acquisition of new equipment and for working capital requirements.



Instrument Rack Shown

Standardized instrumentation and test type
atmospheric sounding rockets, developed by
Geophysics Corp. of America, can measure
the equivalent periods of variable size and
configuration and can withstand severe v-
ibration and shock conditions.

Tesco, Inc., Philadelphia, Pa., is engaged in the manufacture and sale of specially designed and engineered transformers and inductors which are used as components for various types of electronic computers. Offering is 100,000 shares of common stock, the public sale at \$5 per share. Proceeds will be used to further existing bank loans for research and development costs necessary to produce new items currently under development, to finance initial operations of a subsidiary, the balance for general corporate purposes.

Federal Tool and Manufacturing Co., Minneapolis, Minn., engaged primarily in the manufacture and sale of sheet metal stampings out of such metals as sheet strip steel, sheet aluminum, brass, copper, bronze, nickel, beryllium, stainless steel and aluminum alloys, and non-metals as phenolics, nylon and fiber. Officing in 140,000 outstanding shares of common stock is the holder thereof, for public sale at \$5 per share.

Commodity Corp., Hawthorne, Calif., the company and two wholly-owned subsidiaries are principally engaged in the design, development, construction, sale and leasing of specialized equipment for the storage, transportation and pumping of cryogenic liquids and gases. Offering a 108,000 shares of common stock for public sale, public offering.

price and marketing items to be supplied by management. Proceeds will be used to finance the manufacture of ergonomic equipment for loan to employees, to purchase manufacturing and processing equipment, of the balance, a portion will be used to reduce current bank borrowings and the remainder will be added to general funds to meet costs of new product development and for additional working capital.

Federal Electronic Corp., Long Island City, N. Y., engaged in the design and manufacture of microwave test instruments it is also engaged in a number of defense production contracts. The company has secured several contracts with respect to electronic control systems, equipment, communication equipment, precision navigation instruments, and ground support equipment. Other products include radar and other advanced military systems. Offering is 37,000 shares of common stock, which have been or will be noted in exchange for all the issued and outstanding stock of Federal Electronic Corp. The offering of 37,000 shares may be sold by the respondents at prices based upon current prices to as through dealers in the over-the-counter market or as any other suitable securities exchange at \$40/share (37,000 shares for \$1,480,000). An additional 5,000 may be offered. Federal is engaged under military contracts and subcontracts in work relating to coherent and pulse radar systems, long-range defense radar, electronic countermeasures, and communications wave systems.

Edo Corp., College Point, N. Y.; the company and its subsidiaries are engaged in the design, development and manufacture of a variety of types of electronic and electrical equipment and components, specializing in marine (both surface and underway) and airborne devices, and in the design, development and manufacture of specialized steel metal products for use as ships, submarines and aircraft. Offering is 103,071 outstanding shares of common stock, for public sale by the holders thereof, offering price and terms to be determined by prospectus.

Trust Capital Corp., Georgetown, Tex., organized in October, 1918, it is engaged in the business of investing in small business concerns through the

and by making long-term loans to such concerns. Offering is 1,000,000 shares of common for public sale; public offering price and underwriting terms to be supplied by amendment. Proceeds will be used to provide investment capital to enable it to make additional loans and furnish additional managerial services to small business concerns.

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WHAT...

WHO...



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Reeves often races thru fifteen years of comprehensive experience in the design, development, and production of radar tracking and guidance systems. Early achievements include the MX-1 and Gemini fire control systems; MQ-1A class support system, and Multimaster and Terafire guidance radars.

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In addition to complete radar systems, Raytheon also produces extremely accurate two- and three-axis antenna pedestals for control, guidance, and tracking applications. For a copy of our new Pedestal Brochure, write or e-mail our customers (left) with the data file 200.

Qualified engineers acting according to participation in three adjacent fields are invited to act as task staff on



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Photo credit: General Dynamics and Boeing Aircraft Corporation

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The model pictured above shows some design aspects of the new three-engine Boeing 707 short/medium range jetliner. This new jet, already an outstanding sales success, is only one of the Boeing Transport Division programs that can offer you challenging assignments and broad opportunities for advancement. Other programs include Boeing 761 and 730 jetliners and a supersonic transport project.

Expanding Boeing programs have created openings for qualified structural, mechanical and aeronautical engineers at a wide range of experience in research, development,

design, manufacturing and test. Although overall experience is desirable, training and assignments are available on a selective basis, to produce engineers in other fields who wish to apply their capabilities to aircraft projects.

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facilities, recreational facilities, excellent school and housing and beautiful weather. Welcome living for the whole family.

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If you are an experienced engineer or scientist, just a cut above the average, we'd like to tell you more about our company, our community, and how they might fit into your future. You'll find more information on the back of this page and a convenient inquiry card which will receive immediate and confidential attention. Why not mail it today? No obligation, of course.

If the inquiry card has been removed, or if you wish to furnish or request more detailed information, please write to Mr. R. M. Smith, Industrial Relations Administrator-Engineering, Mail Zone 135-80, General Dynamics/Astronautics, 5677 Kearney Villa Road, San Diego 12, California. (If you live in the New York area, please contact Mr. T. Cozzine, manager of our New York placement office, Circle 3-3034.)

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TRANSPORT DIVISION **BOEING**



"FORGING MILITARY SPACEPOWER"

USAF SYSTEMS COMMAND ISSUE

SEPTEMBER 25, 1961

On September 26, AVIATION WEEK and Space Technology will publish one of the most important issues in its history . . . "FORGING MILITARY SPACEPOWER" — USAF SYSTEMS COMMAND ISSUE. For the first time, the complete story of the newly activated USAF Systems Command will be presented to the aerospace industry throughout the world.

The new Systems Command will serve as a single agency to control R&D and procurement of all air-craft, missile, avionics and space systems for the USAF from the idea stage through the time they are in the field ready for use. This concept of a single agency for both systems R&D and systems procurement will have penetrating impact on all aerospace industry companies selling hardware or

research services to the Air Force.

The Systems Command will control approximately \$15 billion in contracts and annually will award \$7.4 billion in new contracts making it the most important single source of aerospace industry business. Further evidence of the impact on industry are policy and procedure changes which can be expected in many areas such as technical approach, contract competition, proposals, cost estimating, management structure and subcontracting.

These are just a few of the important details to be covered in the Systems Command Issue, which will constitute a new handbook in doing business with the Air Force. Teams of AVIATION WEEK editors are now visiting the various bases of the Command for full, complete reports. Detailed edi-

torial coverage will be given to procurement, organization, plans and programs, policies, procedures and future technical activities.

AVIATION WEEK is privileged to present this edition to the industry covering our newest and vitally important Command. Prime contractors, subcontractors, suppliers and firms doing R&D work for the Air Force will be extremely interested in this new issue which will lay the groundwork for future contacts with the Command. It will supersede all previous editions on USAF research, development and procurement policies.

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BUSINESS FLYING



LOCKHEED INTERNATIONAL'S 60, small metal, high-wing monoplane, can be adapted for solid cargoes or agricultural work.

Alaska Airlines to Use, Sell Lockheed 60s

By Arnold Sherman

Alaska Airlines has become the first U. S. airline representative for the Lockheed 60 bush airplane. The Alaska carrier, serving Portland, Seattle Tacoma, Fairbanks, Anchorage, Nome, Kotzebue, and other northern stops, is now the exclusive dealer for the six-passenger aircraft (AW July 4, 1960, p. 93) in the State of Washington and Alaska.

Simultaneously, the airline placed an order for five of the planes which, in

addition to being used as demonstrators, will be integrated into the following sales operations:

- Serving Alaska Airlines' four seasonal passenger, cargo and mail routes: Fairbanks to the Yellowknife, Fairbanks to the Yellowknife, Fairbanks to the Yellowknife, Fairbanks to the Yellowknife.
- Carrying freight loads to Kotzebue, a polar base having 225 in. north-south runway.
- Acting as the basic aircraft for an FAA-approved training program now being established at Seattle, Portland and

Anchorage, for airline and air taxi operators.

Alaska Airlines' President Charles F. Wells, Jr., said the rugged characteristics of the plane make it suitable for the particular conditions inherent in polar terrain flying operations.

Utilization of the Lockheed 60 is seen by Alaska Airlines as an extension of, and supplement to, its West Coast-Alaska service. The airline believes that extra business will be generated from Seattle since parties flying up from the northwest will be able to



LOCKHEED 60 carries on passengers and its cabin has second floor and tie-downs loadings for concentrated cargo loads.



Honeywell Aero... for the best of both



CLIMATE FOR CREATIVITY:

This is an artist's conception of the Air Force space craft Dyna Soar. Honeywell Aero has been selected both as an associate and as a sub-contractor for the critical guidance and flight control subsystems respectively on this delta-winged space craft that will carry one or more astronauts. The Dyna Soar will be sent into space by a Titan launcher.

The Dyna Soar project is representative of the many advanced systems which are being evolved and developed into working hardware at Honeywell Aero. It is typical of the type of creative concept that poses a challenge to the engineer or scientist possessing imagination, drive, and talent.

You will find in the Aero division an opportunity to associate with those who understand, appreciate and respond to the creative individual. In the process you will grow in professional stature and have your accomplishments recognized and rewarded.

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Sailing, canoeing, power-boating, water skiing or fishing, you'll find opportunity for all in the Minneapolis area. Within the city limits are three sailboat docks, five canoe docks, and four large lakes for game fishing. A half-hour away lies famed Lake Minnetonka—"The Land of Sky Blue Water"—more than 200 miles of shoreline and plenty of rooms to set a tack. Nearby, from the miles of waterway of the Mississippi River, the Minnesota River, and the St. Croix River. Wonderful areas for outboard or launch cruising, with hidden islands and coves to test your spirit of adventure. These aquatic pleasures are but one facet of the many recreational, social and cultural enjoyments you and your family will share when you work at Honeywell's Aeronautical Division in Minneapolis.


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There are openings for qualified personnel in each of these areas where you'll find a Climate for Creativity and job satisfaction working on a wide diversification of missile, space and advanced aircraft.

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Advanced Gage Design	Components, Applications and Standards
Flight Control & Reference Systems	Materials Engineering & Physical Chemistry
Measurement & Display Instrumentation	

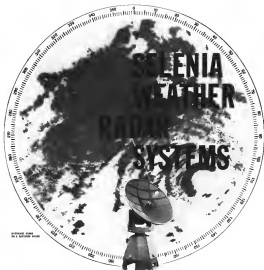
Select your area and send your résumé or request for information on specific openings to: Mr. Clyde W. Hansen, Technical Director, Aeronautical Division, 2026 Ridgway Road, Minneapolis 40, Minn.

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To realize professional opportunities in other Honeywell divisions, send in your résumé and your application in a letter to: Mr. H. B. Edwards, Director, Minneapolis & Montreal. All qualified applicants considered regardless of race, creed, sex or national origin.





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Found Bros. FBA-2 Lightplane Makes Float Test

Found Bros. Aviation Ltd., Milton, Ontario, Canada is testing its newly FBA-2A with Edo Model 2075 floats. The all metal, four five place, 250-hp Lycoming-powered aircraft will be available in a triplane version, the 2B, or a tailwheel version, the 2C, which is suitable for its operators. Each configuration, according to the company, can be mounted on floats.

plane E4 helicopter for transport of Mrs. McN's president on both sides of the country.

One of the 12Es is equipped with a personal boat for lowering and raising geological specimens in dense jungle areas where even a helicopter cannot land.

Three Helix 12Es also are being delivered to the Colombian air force for use in public service and law enforcement. The helicopters are equipped with high compression pistons for high-altitude mountain flying. Two also are equipped with high performance electronic loadpumps.

Helix is delivering one E4 to a water production firm, Sociedad Agricola e Industrial, in Ecuador for use as an executive transport.

Aerocar Negotiating For Sixth Distributor

El Worth, Tex.-Aerocar International has signed distributor contracts covering five sales territories in the U.S. and expects to reach an agreement for a sixth sales outlet covering Texas and Oklahoma.

From distributor-dealer deposits have been advanced to date for more than 570 of the two-place convertible roadable airplanes, Aerocar president Ron Hyde told Aerocar Press. He expects that timing of Air Production of the airplane can begin shortly. Long-Term, which Aerocar has a production agreement (AWR Mar. 27, p. 104) has indicated a previous decline of July 1, by which time 500 units were to have been in, for weather to month and there is to be an increase in the overall price. Hyde expects that testing up will be completed in time to have

decommissioned Aerocar available to distributors and dealers by the end of the year. Plans operations now from San Antonio, outside Washington, Oregon, Idaho, California and Michigan.

Major building in national interest is expected by the company this fall when it begins a new production. Bob Cummings starts his new series, which will feature the Aerocar.



Helicopter Kit Sprays Field in 20-mph. Wind

Different helicopter spray kit, patented by Stall Chemical Co., San Antonio, Tex., applies herbicides in a "maneuverable" container capable of being sprayed in a 20-mph. wind. "Low-dust" herbicide is a product of an insect resistance of water in all herbicide used in a specially designed nozzle. Confirmed for the Bell 47D, B1, C, G-1, G-1A and G-1B helicopters, the spray kit consists of a bellows pressure system of two tanks-one holding water, the other oil and chemicals. Each tank has a lead line to the nozzle where the components are mixed and the insect resistance lowered. Nozzle and the machine in motion, 200 square feet per hour is sprayed at the nozzle with a manual maintained over the machine constantly. Kit includes two 40 or 45 gal. tanks, two electric pump units, hose for each tank assembly, and a three-section spray boom equipped with 45 nozzle orifices that delivers a maximum spray width of 45 ft. at normal operating altitudes. Pressure gauges for each pump assembly are located on a separate panel in the helicopter's cockpit.

Environmental and secondary power systems for multiman spacecraft...



1. Attitude control environmental control system, oxygenic atmosphere supply, cooling system, pressurization and ventilation controls, water purification
2. Backup power system... multiple recovery tactics, pump, detector and computer fuel supplies
3. "Back pack" breathing and pressurization system
4. Secondary power system... multiple recovery tactics, pump, detector and computer fuel supplies
5. Altitude control system reaction motor, fuel and attitude controls
6. Instrumentation... flight data and physiological monitoring systems

Manned space flight requires reliable and efficient thermal and atmospheric systems and secondary power equipment. Complex and integrated systems, as presented, are being studied or under development at The Garrett Corporation. Through optimized design they offer an unmatched degree of compatibility and high performance.

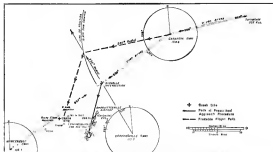
These designs reflect Garrett's 20 years of leadership in developing and producing secondary power and environmental controls for aircraft and spacecraft, including NASA's Project Mercury life support system. This unique capability offers an unmatched source of research, development and production in the government and industry.



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Systems and Components for AIRCRAFT, MISSILE, SPACECRAFT, ELECTRONIC, NUCLEAR AND INDUSTRIAL APPLICATIONS

SAFETY



MAP OF AREA shows current and probable flight paths of DC-3. Note altimeter errors turned by T-28, initial of Garbino's DC-3.

CAB Accident Investigation Report—Part I:

Navigation Error Cited in Piedmont Crash

West 3040, Oct. 10, 1970, Piedmont Airlines Flight 149 crashed on Roanoke Island about 11 mi. west of the Charleston Airfield, Conway, S.C., for post. The crew of 1 and 21 of 24 passengers survived, the sole survivor was seriously injured. The aircraft, a DC-3, N 101, was destroyed by impact.

From the available evidence it is the determination of the board that the crew committed a navigation error in the approach to the runway. The aircraft was on a heading of 100 degrees when it entered the approach to the runway. The aircraft was on a heading of 100 degrees when it entered the approach to the runway. The aircraft was on a heading of 100 degrees when it entered the approach to the runway.

The board concludes that the flight crew was confused by the fact that the runway was on a heading of 100 degrees when it entered the approach to the runway. The aircraft was on a heading of 100 degrees when it entered the approach to the runway. The aircraft was on a heading of 100 degrees when it entered the approach to the runway.

The flight was on a heading of 100 degrees when it entered the approach to the runway. The aircraft was on a heading of 100 degrees when it entered the approach to the runway. The aircraft was on a heading of 100 degrees when it entered the approach to the runway.

The flight was on a heading of 100 degrees when it entered the approach to the runway. The aircraft was on a heading of 100 degrees when it entered the approach to the runway. The aircraft was on a heading of 100 degrees when it entered the approach to the runway.

and analysis of this information it is the board's opinion that the navigation error was a contributing factor in the accident.

INVESTIGATION

Piedmont Airlines Flight 149 was a regular scheduled flight between Washington, D.C., and Roanoke, Va., with intermediate stops at Charleston and Roanoke. On Oct. 10, 1970, the assigned flight crew consisted of Capt. George Lawrence, Pilot in Command, and First Officer, Capt. Robert G. Gentry.

The aircraft departed Washington, D.C., at 10:00 a.m. on Oct. 10, 1970. The flight was on a heading of 100 degrees when it entered the approach to the runway. The aircraft was on a heading of 100 degrees when it entered the approach to the runway. The aircraft was on a heading of 100 degrees when it entered the approach to the runway.

The flight was on a heading of 100 degrees when it entered the approach to the runway. The aircraft was on a heading of 100 degrees when it entered the approach to the runway. The aircraft was on a heading of 100 degrees when it entered the approach to the runway.

As of the 200 deg. initial of the Cassin area. At 10:12 Flight 149 reported first of two area Cassin at 2300 ft. The second report was at 2000 ft. and climbing. The aircraft was on a heading of 100 degrees when it entered the approach to the runway.

The aircraft was on a heading of 100 degrees when it entered the approach to the runway. The aircraft was on a heading of 100 degrees when it entered the approach to the runway. The aircraft was on a heading of 100 degrees when it entered the approach to the runway.

The flight was on a heading of 100 degrees when it entered the approach to the runway. The aircraft was on a heading of 100 degrees when it entered the approach to the runway. The aircraft was on a heading of 100 degrees when it entered the approach to the runway.

THERE IS SOMETHING NEW UNDER THE SUN

Yes, there is something new under the sun. Science is proving it every day. With new discoveries. New explanations. New concepts.

Nowhere is this more evident than in the field of technology. For example. On the drawing boards of Lockheed Scientists and Engineers, new designs are constantly being born—designs in Spacecraft and Aircraft that will survive and enlarge our growing knowledge of Outer Space.

These new designs are rapidly developing. And their number is rapidly increasing. The pace is fast. Yet it needs to become faster. To keep pace, Lockheed needs more Scientists and Engineers. Result? The future for Lockheed was never more promising—the opportunities never greater.

Lockheed feels that trained men will do well to examine thoughtfully the Company's current openings. Notable among

these are: Aerodynamics engineers; thermodynamics engineers; dynamics engineers; electronic research engineers; aerodynamic engineers; electronic systems engineers; physical (physical, infrared, plasma, high energy, solid state, optical); hydrodynamicists; communications scientists; physiological research specialists; solid state electronics engineers; stress engineers; and instrumentation engineers.

Scientists and Engineers: To learn more about the opportunities at Lockheed, write Mr. E. W. Des Lauriers, Manager Professional Placement Staff, Dept. 1106, 2400 N. Hollywood Way, Burbank, California. All qualified applicants will receive consideration for employment without regard to race, creed, color, or national origin. U.S. Citizenship is required. Department of Defense industrial security clearance required.

LOCKHEED CALIFORNIA DIVISION

were made to determine what, if any, modification which might have led to the flight into the canyon, or if the factors were functioning within FAA operating standards. To this end, early 24 hr. surveillance of the incident. The clouds were flown directly into the accident and at various times, night and day, the radar units found in videotape about they were flown by the FAA Flight Inspection Branch using an especially equipped aircraft for the purpose, by the FAA Air Corps Branch, and by Personnel in an air support. No discrepancies were found.

In addition, at the request of the Soviet, the Federal Communications Commission retained the investigators. With special equipment had expert personnel investigation was made to determine if there could any ground phenomena including the operation of electronic equipment in the local area which could adversely affect the normal operation of the Satellite Signal strength. No paper reception was received as appropriate steps were taken for a repeated on-aircraft survey was conducted, and the possibility of spurious radio signals was investigated. After the work was completed, the specimens for the FCC team and north wing was found which would provide an accurate report the actual operation of the approach facilities.

Witnesses' Reports

An intense search resulted in the finding of a series of ground witnesses who had heard a low-flying aircraft because of weather conditions immediately described in cloudy and foggy, had not seen the jet plane but a flight pattern based upon the aircraft engine sound was recorded. The general opinion of the witnesses was that the flight was not preceded by and stopped abruptly in the accident area. Other witnesses were the recognition of time when the aircraft was heard with the estimated progress of flight 340. The latest edge that no other known aircraft reported consistent with the soundpath and in some degree the correlation between the sound movement and the location of the crash site. Because the path was 3.11 mi. west of the airport, a final search was added when at least three persons on the airport facilities for flight 340 stated they did not hear it.

The aircraft was found by the area of witnesses between 2:00-2:05. The fact of the sound was located 5.13 mi. northwest of the accident location. One of these witnesses, an Air Corps man, Captain, stated that the aircraft passed over him as a vehicle heading and it was on his way to the field. Other witnesses were generally along a north-south line which was approximately parallel to the 5.11 mi. west of the normal approach path from Burbank to the airport. Most of these witnesses used the airport terminal as a landmark as if the aircraft was low. Several in the area of White Hall, Grand and Alvarado found the plane approaching from the north and they indicated that from the sound the aircraft made a turn from the south westerly heading to a northwesterly heading and proceeded in the direction of South Elmer Mountain. The direction of the turn was uncertain. (The concluding part of the CAA Accident Report will appear in a subsequent issue of Aviation Week.)

The Lincoln Laboratory program for ballistic missile range measurements and penetration research includes:

EXPERIMENTAL RESEARCH

Measurements and analysis of ICBM flight phenomena for discrimination and for decay design purposes, including optical, aerodynamic and RF effects.

SYSTEM ANALYSIS

Studies to apply research findings to advance the technology of ICBM and AICBM systems.

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Designed radar, optical and telemetry equipment with which to measure ICBM flight effects under actual range conditions.

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Extending the theory and application of radar techniques to problems of discrimination, countermeasures and performance in a dense target environment.

HYPERSONIC AERODYNAMICS

Study of the flowfields around reentering bodies for various body designs and flight conditions. Excellent computer facilities available.

RADAR PHYSICS

Theoretical and experimental studies in radar backscattering. Interaction of RF radiation with plasmas.

A more complete description of the Laboratory's work will be sent to you upon request.

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IR systems requirements for ballistic missile defense.

Optimum signal processing techniques for interplanetary telecommunications.

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If you are interested in helping to solve these questions and are a graduate physicist or engineer with a minimum of three years experience in weapon systems analysis, operations analysis, IR, physics of space, signal processing or communication theory, we invite your inquiry. For immediate consideration, please attach your resume to: **Mr. Robert A. Norris**, Supervisor, Scientific Employment, Hughes Aerospace Engineering Division, Culver City 15, California.

All qualified applicants will be considered for employment without regard to race, color, creed or national origin.

We promise you a reply within one week

HUGHES

SPACE SYSTEMS DIVISION
AEROSPACE DIVISION

WHO'S WHERE

(Continued from page 23)

Honors and Elections

Frederick B. Lee has been appointed chairman of the Naval Safety Council's new General Aviation Safety Committee. Mr. Lee, former Civil Aerospace Administration, is now director of the Aerospace Chemical Corp.'s Washington, D. C., office.

Arch T. Colwell has been elected as a Fellow of the Royal Aeronautical Society of England. Mr. Colwell recently retired in 1964 as general engineering research and development of Thompson Research Laboratories, but continues as a director and consultant.

Changes

Russel Weller, director of engineering Space Systems Division of Lockheed Martin and Space Co., Sunnyvale, Calif.

Charles H. Johnson, vice president and senior projects and systems, Union Carbide, Molecular Sieves, Calif.

Alan A. Neumann and **Vernon B. Edwards** have joined the Washington, D. C., research staff of the Operations Evaluation Group, a part of the Division of Sponsored Research of MIT.

Dr. Peter Magor, assistant director of general sciences Systems Research and Planning Division, Aerospace Corp., Los Angeles, Calif.

John Vial, director astronaut and systems, International Division of Los, Inc., with offices in Paris, France.

Timothy Tefft, director of engineering, Aerospace Corp., New York, N. Y., and **Arturo E. Leland**, chief engineer, Optical Mechanical Department.

T. Gordon Hines, assistant manager development for communications Military Products Division, General Dynamics/Electronics, Fort Worth, Texas.

William H. Eubank, manager advanced projects, Aerospace Communications and Control Division, Defense Electronics Products, Radio Corp. of America, Burlington, N.J.

George M. Laskin, special assistant to the general operations manager, Electronics Operations, Aerospace Corp., The Space and Fuel Inc. Co., Newport Beach, Calif.

E. J. Verrugio, manager White House Range, communications program, Space Radio Corp., New York, N. Y.

K. G. Fikes, project manager for the Defense program and **E. H. Brown**, project manager for the Boeing 707 program, Wingman Aerospace Electronic Department, Lima, Ohio.

Robert E. Ladd, human development administrator, Lockheed Aircraft Service, Jensen, N. Y.

Joseph E. Lufkin, manager of the north-pole, International Operations, General Electric Co.'s Large Jet Engine Department, Evendale, Ohio.

Dr. Robert Branning, director, Nuclear Division, Research and Development, Space Technology Laboratories for Los Angeles, Calif.

Dr. Irene N. Wagoner, associate chief of division, The Garrett Corp., Los Angeles, Calif.

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Aeronautical and Mechanical Engineers holding B.S. degrees are needed for work in solid propellant rocket development programs in the area of mechanical design, development and testing of rocket motor components and assemblies. As M.E. capable Junior Engineers perform evaluations to obtain maximum performance with minimum weight, and do stress analysis of complex, rocket and nozzle structures. These positions entail carrying out design studies of pressure vessels, structural fittings, release and timing mechanisms and, in particular, advanced design concepts in the utilization of high strength materials for high temperature applications.

All inquiries will be acknowledged promptly. Write to:

Dr. B. R. Gossamer, Technical Personnel Department

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E. A. Gossamer, Personnel



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ANALYSIS WITH AND SPACE TECHNOLOGY, August 14, 1961

ELECTRONIC ENGINEERS & PHYSICISTS

REPUBLIC AVIATION NEWS

NEW RECONNAISSANCE ROLE FOR "ELECTRONIC PLANE"

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The development of a reconnaissance capability for Republic's F-102D marks the first "air-to-air" use of an all-weather reconnaissance system with an all-weather airborne weapon system, says a spokesman for the company. The system is the "world's first all-weather, all-weather" system. The new F-102D has already earned the title of the "world's first all-weather, all-weather" system. The new F-102D has already earned the title of the "world's first all-weather, all-weather" system. The new F-102D has already earned the title of the "world's first all-weather, all-weather" system.

With the addition of a sophisticated reconnaissance system the P-1050 becomes a sophisticated electronic warfare platform. System design and analysis of the new reconnaissance package and its electronic platform support present stimulating new challenges to electronic engineers and systems engineers. Optimum integration of the whole electronic complex offers unique problems.

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all heavily programs are locked up to the new Post Office Bureau's & Confidentiality Center, an additional computer effort is underway to transfer the information of all aspects of corporate technology.



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THESE ARE GYRODYNE ROTORCYCLES!

The Great Gyro plane, shown in the inset, was won by a Gyrodyne Rotorcycle for its superior performance at the International Air Show, Le Bourget, Paris-France on June 1, 1981. The Rotorcycle has developed under a U.S. Navy contract for the Marine Corps. An advanced engineering design of the helicopter-like Gyrodyne Rotorcycle was being produced by the U.S. Navy's ASW DASH Program (DASH) research of physics, sensors, weapons, electronics, electronics control systems, and weapons and weapons support systems. These and other related programs are creating career openings for highly qualified administrators and professional engineers as expressed in the following lists:

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Airframe
Propulsion/Installation
Equipment Installation
Electrical

ANALYTICAL

Aviation/Avionics
Weapon Analysis
Reliability
Stability and Performance

MAINTENANCE

Logistics
Detailing
Maintenance/Design
Checklists

TEST ENGINEERS

Flight Test
Structural Test
Stress and Systems

MANUFACTURING

Tool Design
Tool Design Checklists
Shop Layout
Vendor Liaison

ANYONE SYSTEMS

Computer
Digital Data Link
Radio Tracking
Ground Control Equipment

CONTRACT ADMINISTRATION

Program Engineers
Electronic Systems
Business Computers
Electronic Support Equipment

PRODUCT SUPPORT

Field Support
Electronic Equipment
Field Service
Training

ADMINISTRATION—MANAGEMENT

ACCOUNTING—Cost • Audit • Property

CONTRACTS—Administration •

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FINANCE—Corporate • Legal

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U.S. I.

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Because the specific program in which you are assigned plays the key role in generating these satisfactions, you may be able to reach some tentative conclusions after reading thumbnail descriptions of four representative programs at General Electric's Defense Systems Department.

The items described at the right represent only a portion of Defense Systems Department's activities. If your experience is in any of the following areas, we urge you to get in touch with us so that you may get all the facts you need to make the right decision.

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ASTRONOMY

AUTO PILOTS

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GEOMETRIC OPTICS

COMPUTERS

COMPUTER APPLICATIONS ENGINEERING

DATA PROCESSING

GUIDANCE, NAVIGATION

INTEGRAL CALCULUS

NUCLEAR PHYSICS

OPERATIONS ANALYSIS

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PROPAGATION ENGINEERING

RADAR

NAVIGATION PHYSICS

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SYSTEMS ANALYSIS

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LETTERS

Bag Tanks

In candidate I am sending the letter from H. G. Mail (Jet Fuel Tanks) July 14, 1972, at the same time as the first issue appeared on TV of the satellite. Ground DC is accident in Denver. To me the accident is explainable to the letter.

To an airline passenger having been in the air since 1915, I would like to see the design of commercial aircraft go the other way in consideration to Mr. Mail's theory that bag tanks would add stability to the sides of a free passenger in case of an accident and crash landing.

E. W. Durance
St. Charles, Illinois

Parachute Meet

I have just read your editorial, appeared in the National Aeronautics Association, entitled "New Jump or Free" and "One Last Free Fall."

You set to be recommended for general use such a word and accurate approach of the problem and importance of maintaining United States prestige in our struggle with Russia.

In August of 1962 at the invitation of Congress and over the protest of the Soviet Union, the United States will be host to 17 of the most famous of the world for the South World Sport Parachuting Champion ship. This will be the largest international military competition in the history of the West or the Hemisphere.

Parachuting is relatively new in a sport but it means to us more than the famous of the Olympics. It is a test of national prestige and competition. They have to be in on short in the south of leaders of Soviet bloc nations that dominance in the field is important to national defense. In the present time of the people and the poor people rules.

Three of the five previous world paratrooper championships have been held behind the Iron Curtain. These events have been extremely well supported, well run, elaborate and provides training in areas in 600,000 people.

In 1962 the young United States team will be as a fourth place to sport the Soviet applicant. In 1960 it was said but was fourth after fourth place by capture. The United States jumps into a gold and silver medal.

The openness of the championships has in the past resulted in the interest of arms, peace, disarmament and government and military officials. Unfortunately, it might be a case of too free (too late).

There is possibly legislation before Congress regarding it to the championship. It can be that the bill will go far before Congress takes it. If this happens, we will probably have no further opposition to just "one last free fall."

ROBERT A. SCARLETT
COLLIERIES SECURITY
Sport Parachuting
Commission
Orange, Va.

don't say *Work* unless in the opinion of its readers on the same record on the magazine's editorial columns. Address letters to the Editor, *Aviation Week*, 2200 W. 42nd Ave., New York 26, N. Y. Try to keep letters under 500 words and give a personal address. We will not print anonymous letters, but names of writers will be withheld on request.

Cobra Junction Box

The otherwise excellent article by Carol Newman in the July 24 issue entitled "Follow Polaris Cobra as NATO Missile enters a small war."

On p. 67 the penultimate paragraph third column reads as printed in the article: "The missile was fired, a loaded container in each hand, with the control unit. It is a junction box and an additional unit of cable along with the lead."

The cable with the unit weighs 25.1 lb. The weight of the junction box alone is 6.7 lb. and not 25.1 lb. as stated in your article.

RONALD J. MASON
Director of Military Marketing
Development, Inc.
Miami, Fla. 33131

Soviet Aircraft

These Soviet aircraft are also more clever than we thought after seeing the updated pictures from Tehran (for which many thanks).

Yes, and only does Mr. James A. Martin detect engine smoke on the Borealis (U.S. July 13, p. 112). But we have seen a picture.



ADVANTAGES
1. Should be effective to NASA, to it makes maximum use of the MERCURY approach.
2. No external power plants.

FOUND IN THE MAIL: An unsolicited idea upon proposed item as unperfected contractor.

July 17) that images projecting from the Tu-124 wing trailing edge are also not being probably concerning fuel.

Decided to seeing the matter Tu-124 from which the Tu-134 is derived we had not seen from previously noted on that subject these images clearly covered the essential main underwing tank. Clearly, the Tu-124 was built to combat Western observers and conceal the discovery of what the U.S. are called "Whispering" tanks in the U.K. are known as "Richmond" tanks. Could these be "Whispering" tanks or "Euphoric" missiles?

The writer would want with best wishes regarding the first photographs of the Tu-124 operating with only a nose tank to sustain it on the ground. Could the cable run a lightning or electric power? On an O. R. Company Montreal, Canada.

Youth Market

The need of U. S. on citizens across the North Atlantic is to open up unutilized parachute markets and to reveal the area of the same time the U.S. Air Force belong to a bank of unutilized property which is able to support an expanding helicopter market for such special equipment as photographic records and special equipment.

However, both the U.S. Air Force and the U.S. Air Force are looking for ways to utilize unutilized property. It is not open to persons by appropriate its advertising efforts to give young people a chance at a successful start, if the first approximately that of an offshore capital would be more than 1000 to 1000 (see NW Aug. 2, p. 37).

Right light "interplay" in a similar transportation is acceptable to young people who expect to use youth hotel facilities in traveling either coasted or uncoasted through Europe.

Thousands of better students from the same high school in college would find the most accurate information that most of the first one million.

It's up to the airlines to sell them. R. E. Dixon
Berk Hills, Calif.

Strong Jet Engine

Just a short note to point out an error on p. 62 of issue July 17 issue. Somewhere the picture used for the jet engine (General Electric CP1015) or maybe CP1018) is not a jet engine and used in the same way as shown on the picture from a C-130 jet plane.

Bernard Levine
General Electric Co.
Model & Space Vehicle Dept.
Philadelphia, Pa.

Reader Ken, a former employee of GE's Rembrandt (Ohio) facility, is correct. The engine in the photo is a CP1015, and a 28 in. diameter. The photo was taken at the Rembrandt plant—Ed.

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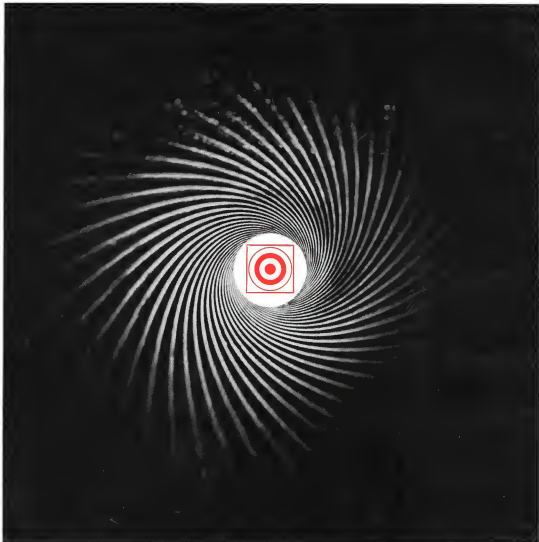
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Mission: take aim on a target you cannot see. Stay on target as your firing platform moves, submerged, 1,200 miles away from the target area. When necessary, send 16 Polaris missiles roaring from the ocean depths, each aimed with rifle shot accuracy.

Bomac Laboratories, working as subcontractor to Lockheed's Missiles and Space Division, helps provide U.S. nuclear submarines with this awesome ability. A tiny Bomac magnetron plays a key role in testing Polaris' complex inertial guidance system. Other Bomac microwave components assist in carrying out constant checks for combat readiness.

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